JUNIPER NETWORKS

RingMaster™

Planning Guide

Release
7.4

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About This Guide

RingMaster 7.4 Planning Guide

This guide is part of a Publications Suite intended for network administrators or persons responsible for installing and managing a Wireless Local Area Network (WLAN) using *RingMaster 7.4* software. This *RingMaster 7.4 Planning Guide* provides an overview and introduction to tools and procedures used for preparing a baseline plan for a Wireless Local Area Network (WLAN) using *RingMaster 7.4* software.

RingMaster 7.4 software provides network planning, configuration and management tools described in detail in this and other *RingMaster 7.4* publications listed below. Preparing a baseline plan for a WLAN, as described in *this* publication, helps you determine equipment and configurations required to meet your network's service goals. This planning precedes physical installation of WLAN equipment.

You plan a WLAN to support services you will offer to employees, guests, and/or customers. As described in detail in the *RingMaster 7.4 Quick Start Guide*, you install *RingMaster Services* and *RingMaster Client* software on selected hosts. You then start using *RingMaster Services* on a host and a *RingMaster Client* on either the same or a different host to begin network planning for a new or extended WLAN.

RingMaster 7.4 Publication Suite

Publications that make up the *RingMaster* Publication Suite are:

- *RingMaster 7.4 Quick Start Guide* — This guide provides a description of prerequisites and procedures required to install and begin using *RingMaster 7.4* software. Information is provided about system requirements for optimum performance, as well as how to install *RingMaster Client* and *RingMaster Services* software.
- *RingMaster 7.1 Planning Guide* (this document) — This guide is described above.
- *RingMaster 7.1 Configuration Guide*— This guide provides instructions for configuring a WLAN with the *RingMaster* tool suite. It describes *RingMaster 7.4* WLAN configuration tools. It is intended for administrators or persons responsible for configuring a WLAN using *RingMaster 7.4* software.
- *RingMaster 7.1 Management Guide* — This guide provides instructions for managing a WLAN with the *RingMaster* tool suite. It describes *RingMaster 7.4* WLAN management and monitoring tools. It is intended for administrators of WLANs using *RingMaster 7.4* software.

Mobility System Configuration and Management

RingMaster 7.4 is used with *Juniper Mobility System* hardware and software, as described in the following publications:

- *Juniper Mobility System Software Configuration Guide* — This guide provides instructions for configuring and managing a system using the Juniper Mobility System Software (MSS) Command Line Interface (CLI).
- *Juniper Mobility System Software Command Reference* — This publication provides functional and alphabetic reference to all MSS commands supported on MXs and MPs
- *Juniper Mobility Exchange Hardware Installation Guide* — Instructions and specifications for installing an MX.
- *Juniper Mobility System Software Quick Start Guide* — Instructions for performing setup of secure (802.1X) and guest (WebAAA™) access, and configuring a Mobility Domain for roaming
- *Juniper Mobility Point MP-422 Installation Guide* — Instructions and specifications for installing an MP access point and connecting it to an MX.
- *Juniper Mobility Point MP-620 Installation Guide* — Instructions and specifications for installing the MP-620 access point and connecting it to an MX.

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- *Juniper Regulatory Information* — Important safety instructions and compliance information that you must read before installing Juniper Networks products

Documentation Conventions

This section describes documentation conventions used by various *RingMaster 7.4* publications.

Safety and Advisory Notices

The following types of safety and advisory notices appear in this guide.

This situation or condition can lead to data loss or damage to the product or other property.

This is a process or procedural tip or other useful suggestion.

This information you should note relevant to the current topic.

This alerts you to a possible risk of personal injury or major equipment problems.

Hypertext Links

Hypertext links appear in Blue.

As an example, this is a link to **Contacting the Technical Assistance Center**.

Illustration Formats

Whenever possible, *RingMaster* screens, windows and dialogs are shown in their entirety, with consistent relative sizes, except where large sizes precludes this, then they are shown as large as possible. In addition to overall screen, window and dialog box resizing, you can adjust columns in tables, etc. to change their appearance. To change these items, move your cursor over a border, column separator, etc. and you will see a “resize” indication (a double ended arrow).

Text and Syntax Conventions

Juniper guides use the following text and syntax conventions:

Convention	Use
`Monospace text`	Sets off command syntax or sample commands and system responses.
Bold text	Highlights commands that you enter or items you select.
Italic text	Designates command variables that you replace with appropriate values or highlights publication titles or words requiring special emphasis.

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Convention	Use
Bold italic text font	Bold italic text font in narrative, capitalized or not, indicates a program name, function name, or string.
Menu Name > Command	Indicates a menu item. For example, File > Exit indicates that you select Exit from the File menu.
[ ] (square brackets)	Enclose optional parameters in command syntax.
{ } (curly brackets)	Enclose mandatory parameters in command syntax.
| (vertical bar)	Separates mutually exclusive options in command syntax.

For information about Trapeze support services, visit
http://www.trapezenetworks.com/supportportal/,
or call 1-866-877-9822 (in the US or Canada) or +1 925-474-2400 and select option 5.

Juniper Networks sells and services its products primarily through its authorized resellers and distributors. If you purchased your product from an authorized Juniper reseller or distributor and do not have a service contract with Juniper Networks, you must contact your local reseller or distributor for technical assistance.

Contacting the Technical Assistance Center

Contact the Juniper Networks Technical Assistance Center (TAC) by telephone, email, or via web support portal.

- Within the US and Canada, call 1-866-TRPZTAC (1-866-877-9822).
- Within Europe, call +31 35 64 78 193.
- From locations outside the US and Canada, call +1 925-474-2400.
- In non-emergencies, send email to support@trapezenetworks.com
- If you have a service contract or are a Juniper Authorized Partner, log in to http://www.trapezenetworks.com/supportportal/ to create a ticket online.

TAC Response Time

TAC responds to service requests as follows:

Contact Method	Priority	Response Time
Telephone	Emergency	One hour
	Non-emergency	Next business day
Email	Non-emergency	Next business day

Information Required When Requesting Service

To expedite your service request, please have the following information available when you call or write to TAC for technical assistance:

- Your company name and address
- Your name, phone number, cell phone or pager number, and email address
- Name, model, and serial number of the product(s) requiring service
- Software version(s) and release number(s)
- Output of the *show tech-support* command
- Wireless client information
- License levels for *RingMaster™* and *Mobility Exchange™* (MX™) products

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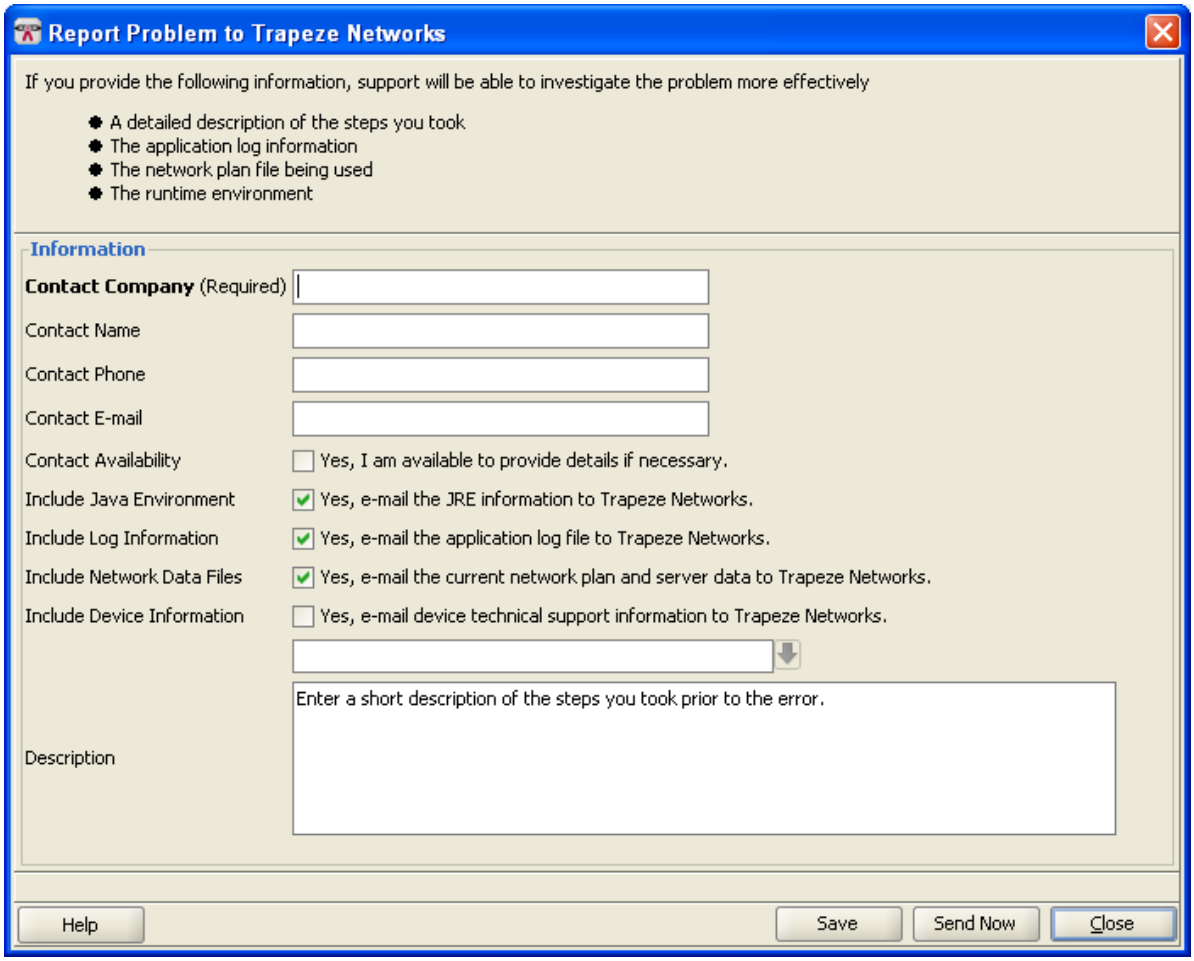
- Description of any problems and status of any troubleshooting effort

Main Menu “Report Problem” Tool

You can click **Help** from the *RingMaster* Menu bar to access online help and to send a report to Trapeze TAC electronically:

1. Select **Help** > **Help** to display HTML help about configuring and using *RingMaster*.
   Select Help > Report Problem to report a problem to Juniper Technical Support. This dialog allows you to report problems to Juniper Networks by filling in particulars and then clicking Send Now to compose and send an email to Juniper.


Report Problem to Trapeze Networks
If you provide the following information, support will be able to investigate the problem more effectively
A detailed description of the steps you took
The application log information
The network plan file being used
The runtime environment
Information
Contact Company (Required)
Contact Name
Contact Phone
Contact E-mail
Contact Availability
Yes, I am available to provide details if necessary.
Include Java Environment
Yes, e-mail the JRE information to Trapeze Networks.
Include Log Information
Yes, e-mail the application log file to Trapeze Networks.
Include Network Data Files
Yes, e-mail the current network plan and server data to Trapeze Networks.
Include Device Information
Yes, e-mail device technical support information to Trapeze Networks.
Description
Enter a short description of the steps you took prior to the error.
Help
Save
Send Now
Close

Warranty and Software Licenses

Current Juniper Networks warranty and software licenses are available at http://www.trapezenetworks.com/support/warranty.

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Agreement are incorporated herein in its entirety in this Terms and Conditions of Sale ("Terms and Conditions of Sale") by this reference. The terms of the Software License Agreement control, except for the limited warranty set forth below ("Limited Warranty").

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   Trapeze Networks, Inc. ("Trapeze Networks" or "Trapeze") warrants to Customer, subject to the limitation and disclaimer below, that all Trapeze hardware will be free from defects in material and workmanship under normal use as follows: (a) if the hardware was purchased directly from Trapeze Networks, for a period of one (1) year after original shipment by Trapeze Networks to Customer or (b) if the hardware was purchased from a Trapeze Networks Authorized Reseller, for a period of one (1) year from the date of delivery to Customer, but in no event more than fifteen (15) months after the original shipment date by Trapeze ("Limited Hardware Warranty").
   The date of original shipment from Trapeze Networks will be determined by shipping evidence on file at Trapeze Networks. This Limited Hardware Warranty extends only to the Customer who was the original purchaser of the hardware and may not be transferred to any subsequent repurchasing entity. During the Limited Hardware Warranty period upon proper notice to Trapeze Networks by Customer, Trapeze Networks will, at its sole option, either:
   - Repair and return of the defective hardware;
   - Replace the defective hardware with a new or refurbished component;
   - Replace the defective hardware with a different but similar component that contains compatible features and functions; or
   - Refund the original purchase price upon presentation of proof of purchase to Trapeze Networks.

3. Restrictions on the Limited Hardware Warranty.

   This Limited Warranty does not apply if hardware (a) is altered from its original specifications, (b) is installed, configured, implemented or operated in any way that is contrary to its documentation, (c) has damage resulting from negligence, accident, or environmental stress, (d) was subject to unauthorized repair or modification or (e) is provided to Customer for pre-production, evaluation or charitable purposes.

4. Limited Software Warranty

   Trapeze Networks warrants to Customer, subject to the limitation and disclaimer below, that the software will substantially conform to its published specifications as follows: (a) if the software was purchased directly from Trapeze Networks, for a period of ninety (90) days after original shipment by Trapeze Networks to Customer or (b) if the software was purchased from a Trapeze Networks Authorized Reseller, for a period of ninety (90) days from the date of delivery to Customer commencing not more than ninety (90) days after original shipment date by Trapeze), ("Limited Hardware Warranty"). The date of original shipment from Trapeze Networks will be determined by shipping evidence on file at Trapeze Networks. This Limited Software Warranty extends only to the Customer of original purchaser of the software and may not be transferred to any subsequent repurchasing entity.

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   Where repair or replacement is required under the Limited Warranty, Customer will contact Trapeze Networks and obtain a Return Materials Authorization number (“RMA Number”) prior to returning any hardware and/or software, and will include the Trapeze Networks RMA Number on all packaging. Trapeze Networks will ship repaired or replacement components within a commercially reasonable time after receipt of any hardware and/or software returned for the Limited Warranty purposes to the address provided by Customer. Customer will pay freight and handling charges for defective return to the address specified by Trapeze Networks and Trapeze Networks will pay freight and handling charges for return of the repair or replacement materials to Customer.

9. Miscellaneous

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Introduction to RingMaster 7.4

Starting RingMaster Services

Before using the *RingMaster Client* to perform any planning functions, you must start *RingMaster Services* on its host. The method used to start *RingMaster Services* depends on the platform where it is installed:

- Windows systems — RingMaster Services are started automatically when you complete software installation and whenever you restart the host system.
- Linux systems — You can start and stop RingMaster Services manually from a command line interface using a shell script that is installed when you install RingMaster Services. You can configure RingMaster Services to start and stop automatically.
- Macintosh OS systems — RingMaster Services are not started automatically, so you must start them manually.

Starting RingMaster Services on a Linux system

To start *RingMaster Services* manually, type:

```
prompt# rm-services start
```

To stop *RingMaster* Services manually, type:

```
prompt# rm-services stop
```

These examples assume *RingMaster Services* are installed in the default location.

Configuring RingMaster Services as a Daemon on SUSE 9.1

To add services to a SUSE 9.1 installation, use the **insserv** command.

Enter the following commands (as **root**):

```
suse# cd /etc/init.d
suse# ln -s /opt/ringmaster/bin/rm-services rm-services
suse# insserv rm-services
```

Configuring RingMaster Services as a Daemon on Red Hat WS 3

To add services to a Red Hat WS 3 system, use the *chkconfig* command.

Enter the following (as root):

```
redhat# cd /etc/init.d
redhat# ln -s /opt/ringmaster/bin/rm-services rm-services
redhat# chkconfig --add rm-services
```

Starting RingMaster Services on Macintosh Systems

To start *RingMaster Services* manually, open a *Terminal* window, either by using the shortcut on the dock, or by browsing to */***Applications/Utilities** and launching *Terminal* from there. In the *Terminal* window, change to the **bin** directory in the *RingMaster* installation directory. By default, this is */* **Applications/RingMaster/bin**.

For example:

```
# cd /Applications/RingMaster/bin
```

To start *RingMaster Services*, enter:

```
# sudo ./rm-services start
```

Enter the password, if prompted.

To stop or restart *RingMaster Services*, enter:

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```
# sudo ./rm-services stop
# sudo ./rm-services restart
```

Either of these commands may require you to enter a password. These examples assume that *RingMaster Services* is installed in the default location.

Using RingMaster with HP OpenView

If you installed the HP *OpenView* plug-in during *RingMaster* installation, you can use HP *OpenView* in conjunction with *RingMaster* to manage a Juniper Networks Mobility System.

Preparing to Use HP OpenView and RingMaster

Before using HP *OpenView* and *RingMaster*, make sure you have the following configured:

- SNMP trap receivers (Refer to “Configuring SNMP” in the publication RingMaster 7.4 Configuration Guide.)
- Syslog servers (See “Viewing and Setting Log and Trace Settings” in the publication RingMaster 7.4 Configuration Guide.)

Starting RingMaster from Network Node Manager

You can start *RingMaster* directly from the main *Network Node Manager* window.

To start *RingMaster* from *Network Node Manager*:

1. Start *Network Node Manager*. The **Network Node Manager** window appears.
2. In the main **Network Node Manager** window, do one of the following:
   - Select Tools > Trapeze Networks > RingMaster.
   - Click the Trapeze Networks icon in the toolbar.
   - Right-click (Macintosh: Control+click) a Trapeze MX, and select RingMaster.

   The main *RingMaster* window appears.

Using the RingMaster Client for Planning

After *RingMaster Services* have been started on a server, a *RingMaster Client* can be used to perform WLAN planning functions.

1. Start the *RingMaster Client* by doing one of the following:
   - On Windows systems, use the desktop icon placed by the installer, or select Start > Programs > Trapeze Networks > RingMaster > RingMaster.
   - On Linux systems, change directories to:

```
RingMaster_installation_directory/bin
```

and enter

```
./ringmaster.
```

   - On Macintosh OS systems, select Finder > Applications > RingMaster, or click the RingMaster icon in the dock. The RingMaster Services Connection dialog displays.
2. Enter the IP address or fully-qualified hostname of the server on which *RingMaster Services* are installed. If *RingMaster Services* is installed on the same machine as the one running *RingMaster Client*, enter 127.1.0.1 as the IP address. This is a standard IP loopback address.
3. Specify a service port, if different from the port number in the **Service Port** listbox.

4. Click **Next** to connect to the server.
5. If a **Certificate Check** dialog is displayed, click **Accept**. If the **Open Network Plan** option on the **RingMaster Services Connection** dialog is selected, the server opens a new (Default) network plan icon in the **Organizer** panel at its left side.

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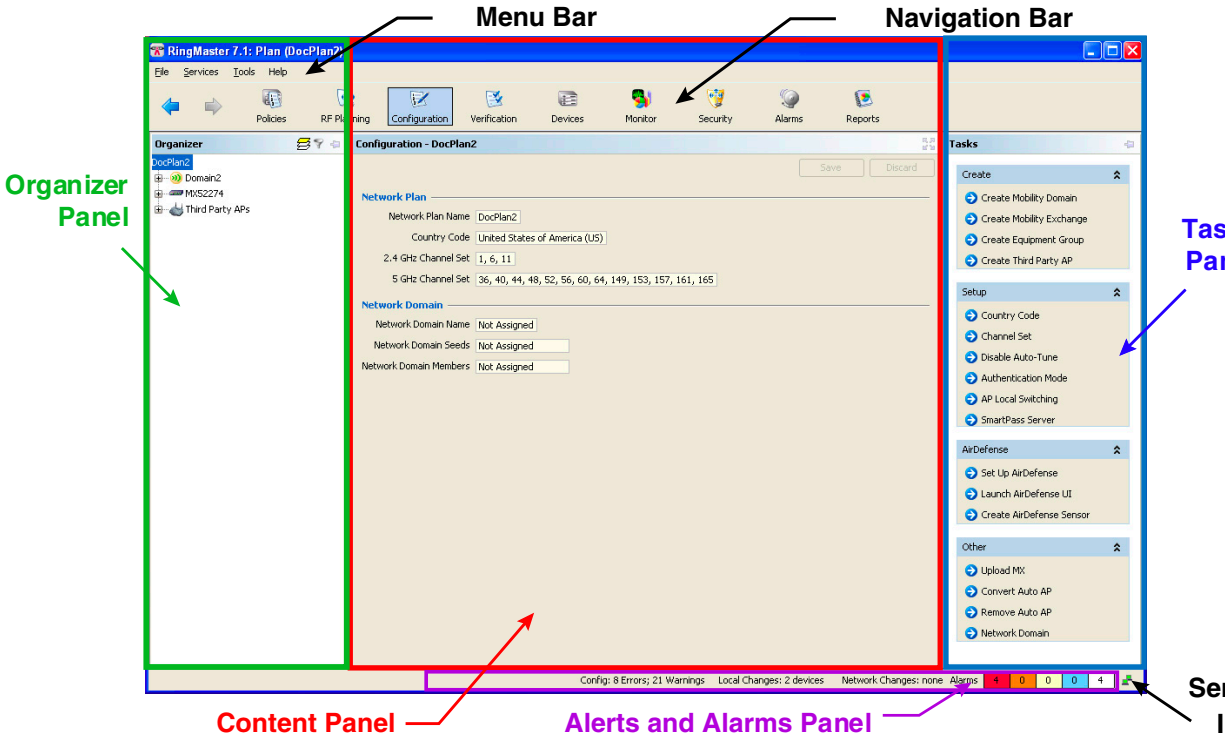
RingMaster Client Main Window

RingMaster software presents a Graphical User Interface (GUI) to its users, consisting of a series of screens, windows, and dialog boxes. In many cases, sample images of these GUI elements have been included in this publication. The *RingMaster* GUI allows you to resize these elements, and this has been done to minimize element illustration sizes in this publication, while retaining all of the information visible in them. This resizing of screens, windows and dialog results in illustrations that may differ in appearance from what you may see on your workstation display.

The *RingMaster Client* presents a **Main Window** similar to the one shown below.



- The Menu bar provides pull-down menus containing selectable items for accessing administrative tools such as plan management and online Help. For example, to examine RingMaster logging preferences, select Tools > Preferences and click the Logging tab.
- The Navigation bar provides buttons by which you access features and summary views. For example, you use the Back and Forward buttons to cycle through display selections.
- The Organizer panel displays a network tree representing WLAN devices and configurations on those devices. You can use it to navigate to policy configurations, equipment within your network, and network sites. When you select a device or configuration in the tree, context-sensitive information about a device or configuration is displayed in the Content panel.
- The Content panel displays context-sensitive information about the device or configuration selected from the tree in the Organizer panel. This information may be in the form of a table, a floor view, details panels, a four-segment “dashboard” layout Outdoor Area view. From the Content panel, view Juniper devices and status, verify Juniper device configurations in the network plan and in the network, and display event logs and rogue detection results.
- The Alerts and Alarms panel displays configuration errors, network alarms, rogue detection, local and network changes. Click on a button or summary to display details.
- The Tasks panel displays context-sensitive actions for a Tool button/Organizer selection.
- The Server icon indicates the status of the connection between the RingMaster Client and the host running RingMaster Services.

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For additional details regarding the components of the *RingMaster Client* main window, refer to “RingMaster User Interface” in the publication *RingMaster 7.4 Configuration Guide*.

Accessing RF Planning Tools

RingMaster planning tools determine necessary equipment, configuration, and installation locations based on information provided about WLAN needs. You specify outdoor coverage areas and plan installations in buildings, internet cafes, student campus locations, or anywhere a wireless network is needed. When you have added geographical information about a network, you can use *RingMaster* to find network clients or rogue devices visually.

To access RF planning tools, select the **RF Planning** Navigation Bar button and do one of the following:

- If you are adding a new building, click on a site name icon in the Organizer panel and select Create Building in the Tasks panel. (See Adding Buildings and Floors to an Existing Site.)
- If you are creating outdoor coverage areas, click Create Outdoor Area.
- If you are modifying an existing building, click on the plus sign next to a site name to expand it, then click on the name of the building you want to modify.

Configuration Using Wizards

In many cases, *RingMaster* provides a *series* of dialog boxes that guide you through a configuration process. After completing entries and selections in one dialog box, you click **Next** or **Save and Continue** to proceed with a task. The “wizard” presents the next dialog you should use to proceed, in the recommended sequence, to complete an overall configuration task. Although there are other ways to view and/or alter configuration settings later, these wizards are helpful for completing initial setups using the guidance of wizards designed to enforce best practices.

Configuration Using Dialog Boxes

RingMaster dialog boxes allow you to specify options and perform actions. You can right-click (on Macintosh it is Control+click) on many objects to display optional actions.

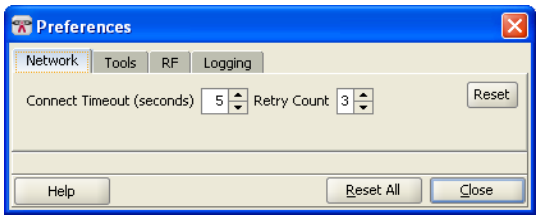
User Interface Details

For a more complete description of the *RingMaster* GUI, refer to “RingMaster User Interface” in the publication *RingMaster 7.4 Configuration Guide*.

Setting Preferences

You can set **Network**, **Tools**, **RF** and **Logging** preferences.

1. Select **Tools > Preferences** from the *RingMaster* main menu bar. The **Preferences** window is displayed.



The Network tab is displayed first, where you can change the following:

- Connect Timeout
- Retry Count for Server communications.

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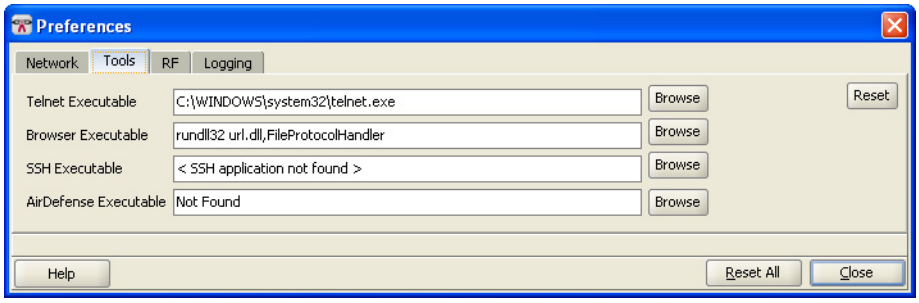
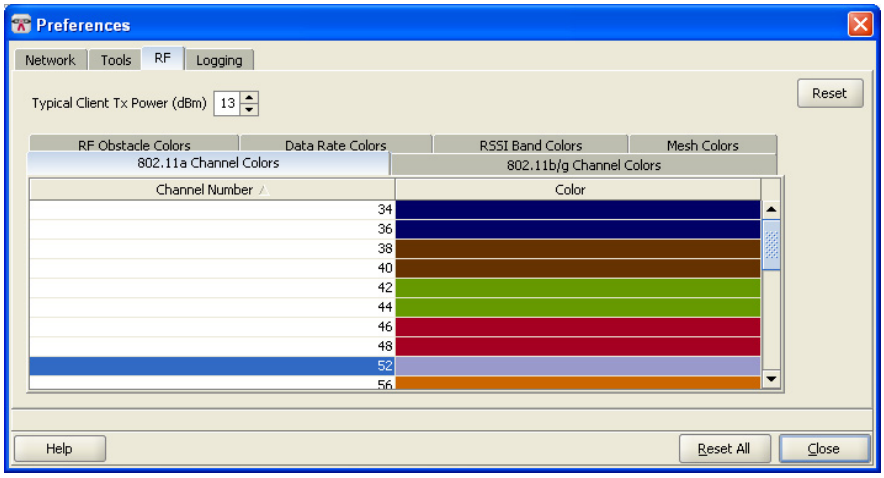
You can Reset to restore previous values in this tab or Reset All to reset preferences to defaults.

Select Close to exit and leave changed values, or click on another tab in the dialog box.



2. The **Tools** tab is used to select paths to software tools, including:

   - Telnet Executable
   - Browser Executable
   - SSH Executable
   - AirDefense Executable



3. The **RF** tab presents a multi-tabbed Preferences dialog box that allows you to select colors to be used to display items listed in the tabs in the dialog. This includes the following:

   - 802.11a Channel Colors
   - 802.11b/g Channel Colors
   - RF Obstacle Colors
   - Data Rate Colors
   - RSSI Band Colors
   - Mesh Colors

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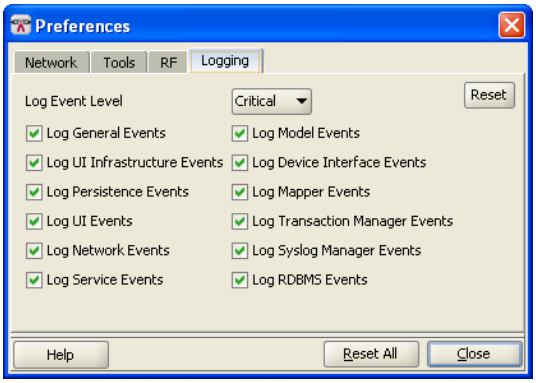

4. The **Logging** tab allows you to select items to be saved in logs and later used for reports generated by *RingMaster*.
   This includes the following:

   - Log General Events
   - Log UI Infrastructure Events
   - Log Persistence Events
   - Log UI Events
   - Log Network Events
   - Log Service Events
   - Log Model Events
   - Log Device Interface Events
   - Log Mapper Events
   - Log Transaction Manager Events
   - Log Syslog Manager Events
   - Log RDBMS Events

   There is also a pull-down menu from which you can select reported alarm levels.
   These options are:

   - Critical
   - Warning
   - Info
   - Debug

Getting Help

Click **Help** from the Main menu bar to access online help and other information:

1. Select **Help** > **Help** to display HTML help about configuring and using *RingMaster*.

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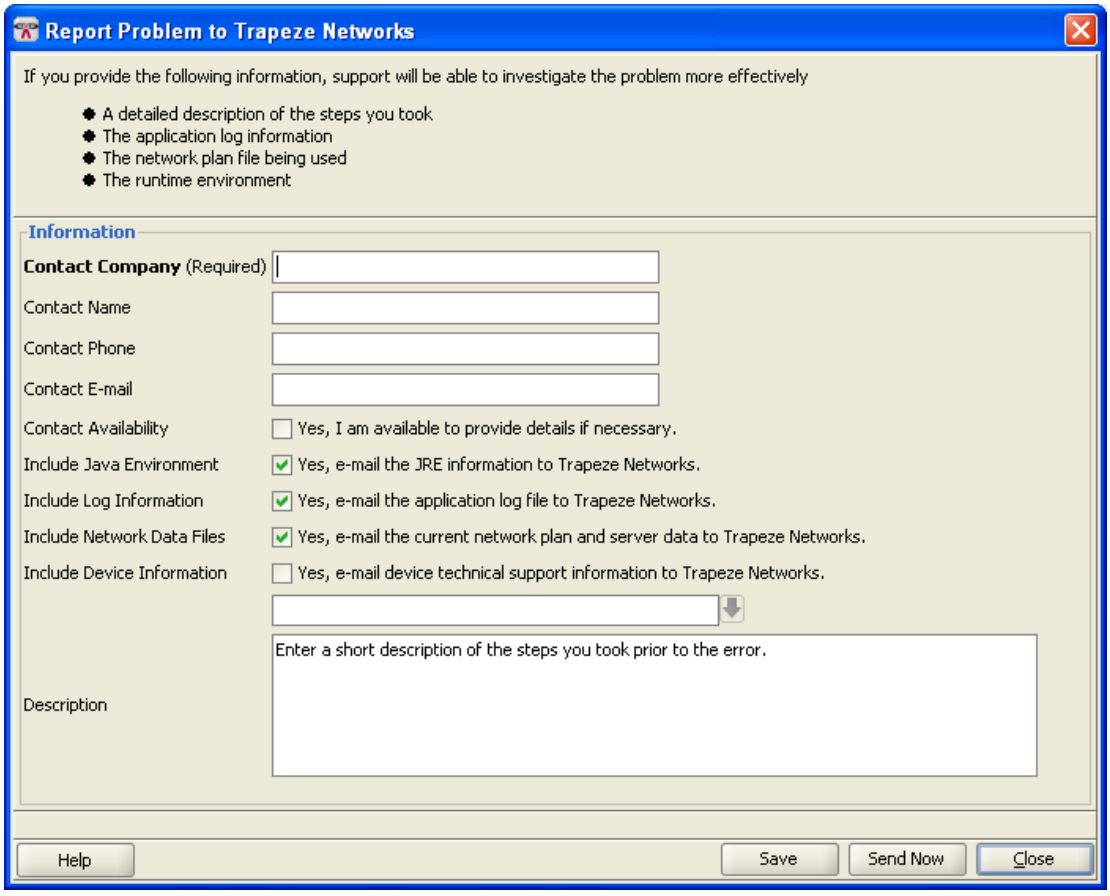
Select Help > Report Problem to report a problem to Juniper Technical Support. This dialog allows you to report problems to Juniper Networks by filling in particulars and then clicking Send Now to compose and send an email to Juniper.


Report Problem to Trapeze Networks
If you provide the following information, support will be able to investigate the problem more effectively
A detailed description of the steps you took
The application log information
The network plan file being used
The runtime environment
Information
Contact Company (Required)
Contact Name
Contact Phone
Contact E-mail
Contact Availability
Yes, I am available to provide details if necessary.
Include Java Environment
Yes, e-mail the JRE information to Trapeze Networks.
Include Log Information
Yes, e-mail the application log file to Trapeze Networks.
Include Network Data Files
Yes, e-mail the current network plan and server data to Trapeze Networks.
Include Device Information
Yes, e-mail device technical support information to Trapeze Networks.
Description
Enter a short description of the steps you took prior to the error.
Help
Save
Send Now
Close

Select Help > About RingMaster to display information about RingMaster as shown below:

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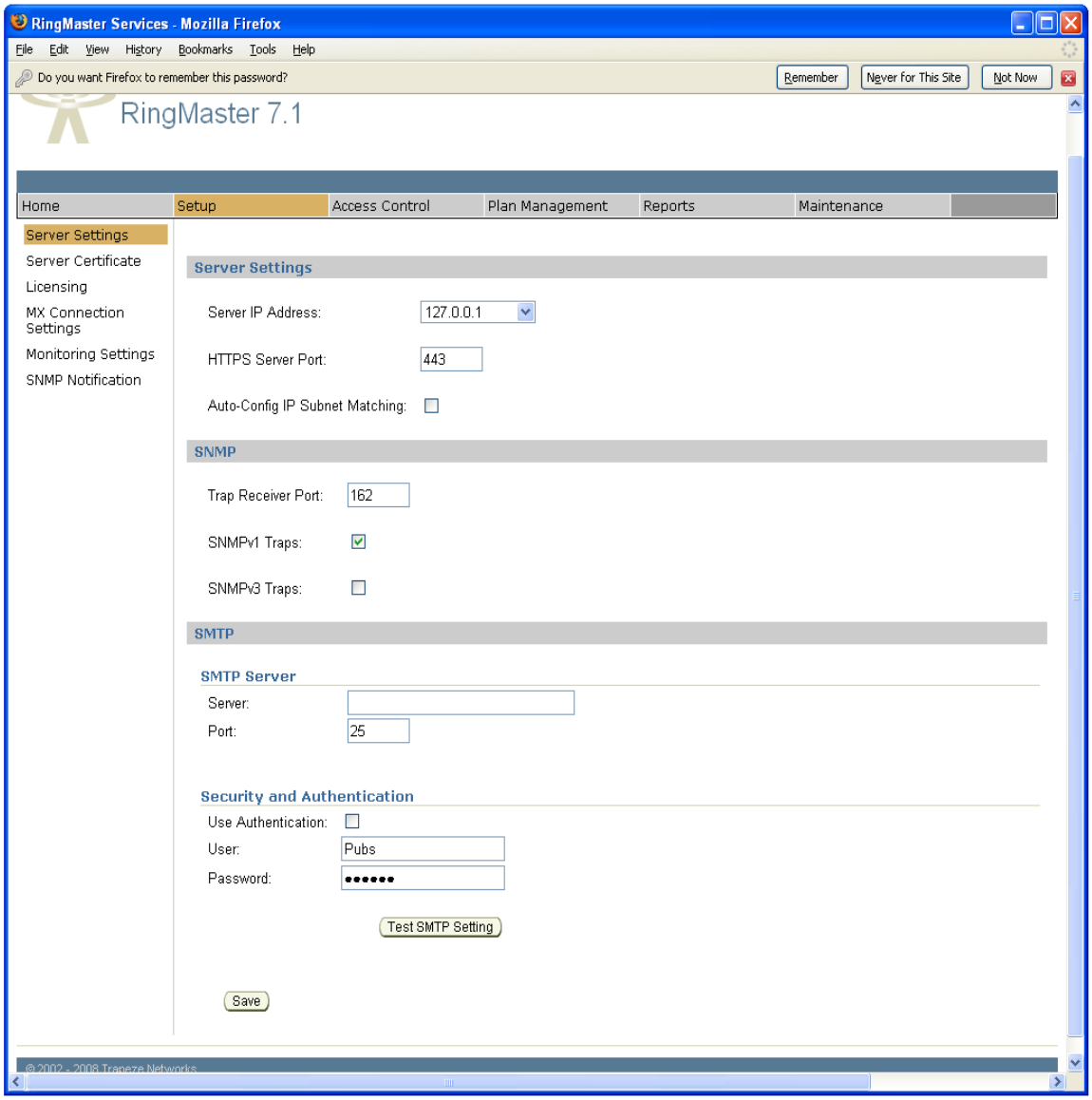
Configuring RingMaster Services

You can change the properties of *RingMaster Services*.

If a firewall is enabled on the host where you install *RingMaster Services*, *RingMaster Services* cannot communicate with *RingMaster Client* or with MXs unless the firewall is configured to allow through traffic for the SSL and SNMP ports (443 and 162 by default).

---

1. Select **Services > Setup** from the *RingMaster* main menu bar**.** *RingMaster Services* opens in your default Web browser.



By default, a username and password are not required to access *RingMaster Services* from *RingMaster Client*. You can configure user accounts for administrative, provisioning, and monitoring access. (Refer to **Improved Access Control**.)

2. Configure the following options:

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- Trap receiver port is for traps generated by MXs
- HTTPS server port is for RingMaster (RM) clients

3. Specify security settings in the **Key Store** area. The **Auto-Config IP Subnet Matching** option is used for field replacement of MXs. For information, refer to the *RingMaster 7.4 Configuration Manual.* Click **Access Control** on the left to define user accounts. For more information about access control, refer to **Improved Access Control**.

Selecting Monitoring Settings

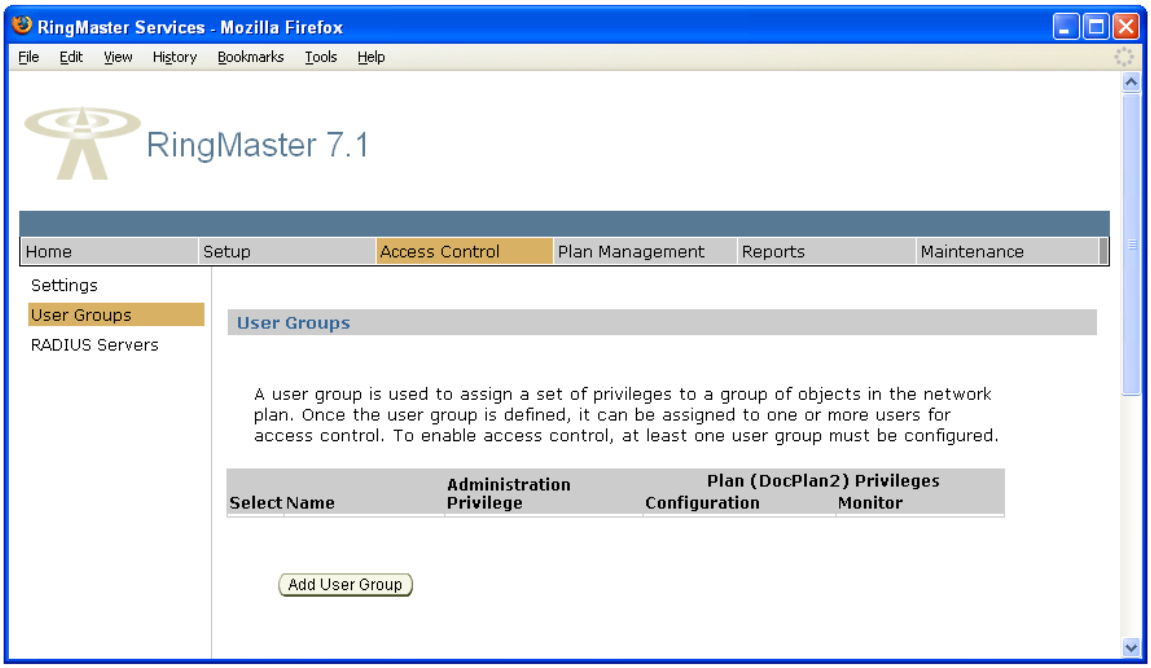
All monitoring options are enabled by default. You do not need to enable them and you do not need to specify the switches you want to monitor. However, for *RingMaster Services* to receive trap data from MXs, SNMP notifications must be enabled and *RingMaster Services* must be configured as a notification target on each of the switches. To start gathering data for monitoring, deploy your configuration to the network. For information about deploying your configuration, refer to **Deploying a Network Plan**.

Improved Access Control

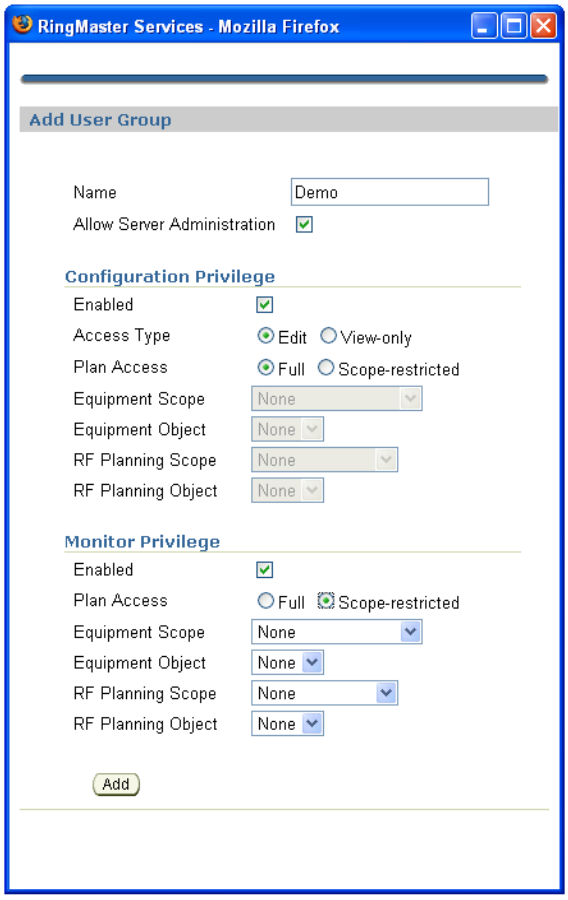
Users and Groups

To configure access for users and groups:

1. Select **Services > Setup** from the *RingMaster* menu bar. *RingMaster Services* is displayed in your default Web browser**.**
2. Select the **Access Control** tab.
3. Select **Settings** and then **User Groups**.


RingMaster Services - Mozilla Firefox
File Edit View History Bookmarks Tools Help
RingMaster 7.1
Home
Setup
Access Control
Plan Management
Reports
Maintenance
Settings
User Groups
RADIUS Servers
User Groups
A user group is used to assign a set of privileges to a group of objects in the network plan. Once the user group is defined, it can be assigned to one or more users for access control. To enable access control, at least one user group must be configured.
Select
Name
Administration Privilege
Plan (DocPlan2) Privileges
Configuration
Monitor
Add User Group

You must add a User Group before you can add Users. Click Add User Group.



You assign a User Group Name and make the following selections:

- Check Allow Server Administration to allow this privilege or clear if denying it.
- Check Configuratio Privilege Enabled to allow this or clear if denying it.
- Select Access Type as Edit or View-only
- Select Configuration Access as Full or Scope-restricted (as defined by settings below, including:
  - Equipment Scope
  - Equipment Object
  - RF Planning Scope
  - RF Planning Object
- Check Monitor Privilege Enabled to allow this or clear if denying it.
- Select Plan Access as Full or Scope-restricted (as defined by settings below, including:
  - Equipment Scope
  - Equipment Object
  - RF Planning Scope
  - RF Planning Object

Click Add.

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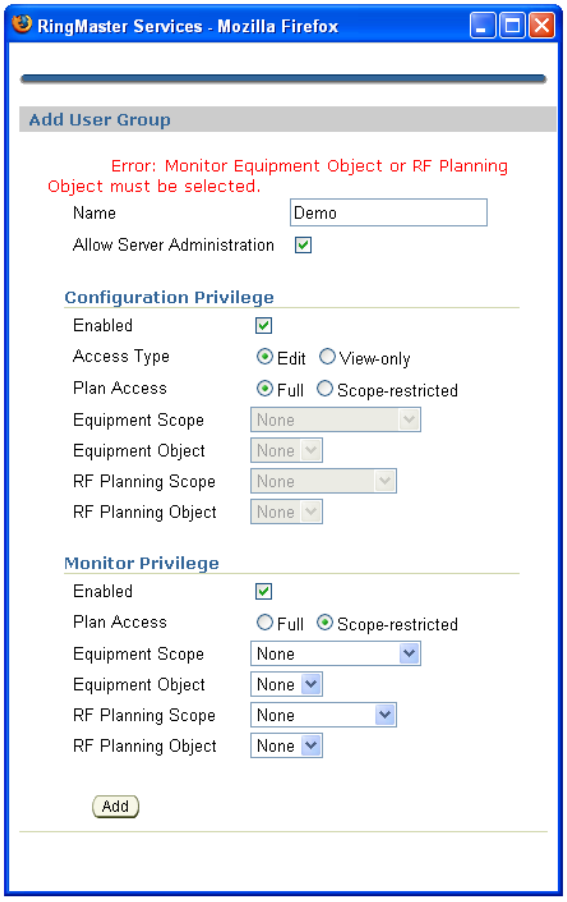
If there is an error, you will see a notice in the dialog box with an explanation:



Make corrections and click Add again.

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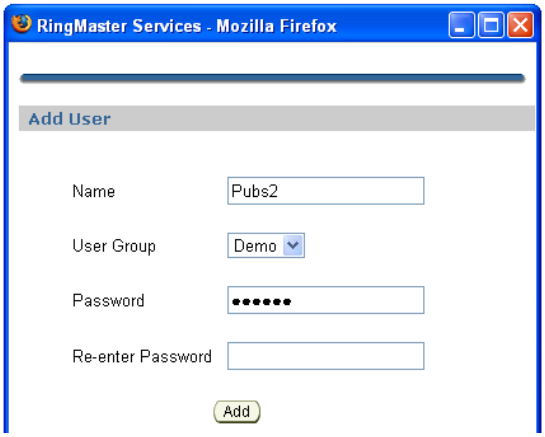
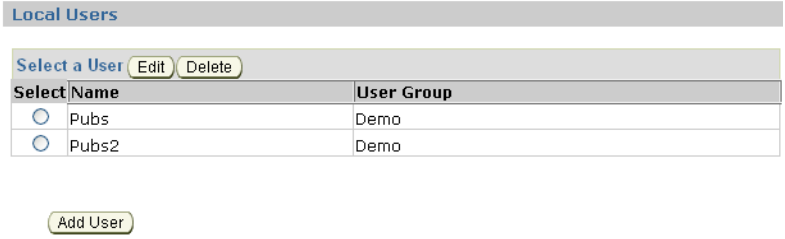
4. Select **Settings**.

RingMaster Services - Mozilla Firefox
File Edit View History Bookmarks Tools Help
RingMaster Services
RingMaster Services
RingMaster 7.1
Home
Setup
Access Control
Plan Management
Reports
Maintenance
Settings
User Groups
RADIUS Servers
Access Control
Currently RingMaster services allows all users to access RingMaster without a user name and password being required. To enforce user login control for RingMaster services, select the login-required option below. (To enforce logins with a user name and password at least one user with the Service Administrator privilege needs to be created).
Enable login-required
Local Users
Select Name
User Group
Add User

5. Click **Add User** now that there is a group available.



6. Create **Name,** select a **User Group,** assign a **Password**. Re-enter the **Password**.
7. Click **Add**. The new user appears in the list.



8. To remove, click **Delete** next to the desired user.
9. To reset a password, click **Edit**.

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10. To enable and require use of passwords, go to **Access Control > Settings** and select **Enable log-in Required**. (This toggle with **Allow all users**, which allows password access to be turned off.)

RADIUS Servers

To configure access for RADIUS Servers:

1. Select **Services > Setup** from the *RingMaster* menu bar. *RingMaster Services* is displayed in your default Web browser**.**
2. Select the **Access Control** tab.

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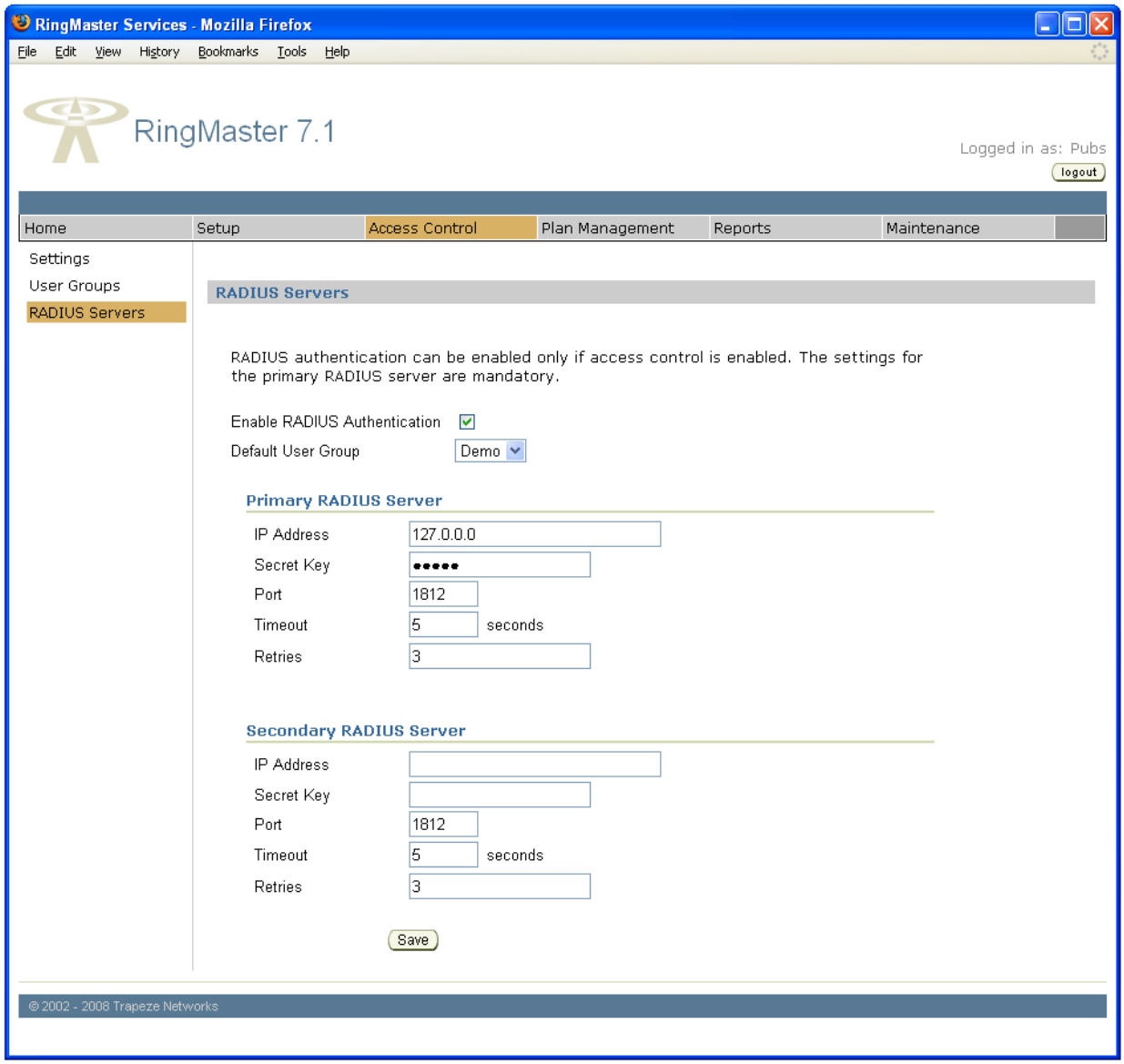
3. Select **RADIUS Servers**.



Select Enable RADIUS Authentication or clear it to enable or disable it.

Select a Default User Group.

Provide information for Primary RADIUS Server and Secondary RADIUS Server as desired.

Click Save.

Providing Services

A network service is defined by a set of options you configure and deploy on a WLAN. Services are configured to support various levels of network access. For example, a service configured to support employee access has options that provide greater access to a network. Services configured for guest access have limited or no internal network access, but provide Internet connections. A service can be fully isolated and independent from other services on a WLAN (multi-hosted access is typically isolated), or can re-use portions of a service configured for some other service. Services may have authentications such as 802.1X, Web page, MAC address, or “last resort”. They may include encryptions such as 802.11i, WPA, WEP, or they may be unencrypted.

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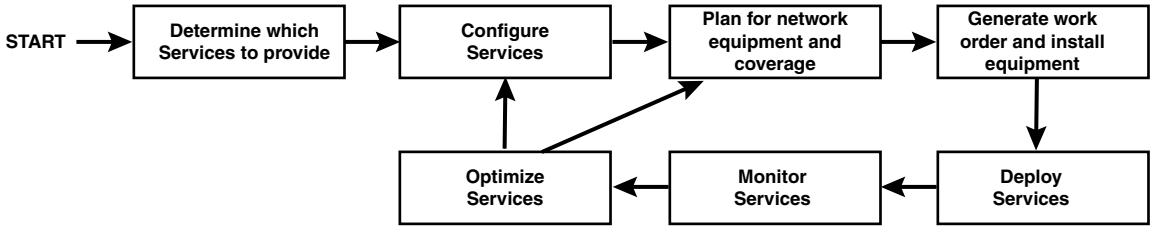
Figure 1–1 describes the process of establishing services, starting with determining the services to offer. Each step in this process is described in this chapter.

Figure 1–1. Establishing Wireless Services



Understanding Service Types

You need a clear understanding of the service types you will configure with *RingMaster* before planning and configuring a network. First, determine which services your organization requires.

The following are three common types of services:

- Employee access
- Guest access
- Voice over Wireless IP (VoWIP)

Employee access is typically secure, encrypted access to a wireless network. Guest access is access (possibly unencrypted) provided for visitors. If you intend to resell services to other providers, you must provide multi-hosted access. Determining services you need at the beginning of the planning process results in collection of configuration data. This data is used to create service profiles and Authentication, Authorization, and Accounting (AAA) rules for a service. A *radio profile* is a common set of configuration parameters to be applied to many AP radios. See **Providing Services** for information about configuring services.

Creating A Network Plan

A network plan is used in *RingMaster* to design a wireless network. An icon representing a network plan is placed in the **Organizer** panel. This icon is appears at the top of a hierarchy of icons representing all your WLAN devices and lists their services, policies, etc. You can better manage and visualize a network's topology by creating a detailed and accurate network plan.

You start by creating a device-oriented (MX and AP) view of your network with geographic information for your site — no floor dimensions, building material information, or RF obstacle information. You provide geographic information by adding floor dimensions, RF coverage area, and attenuation information, such as elevator shafts or internal concrete walls.

If you want the benefits of network monitoring and visualization, you create a detailed network plan. This is done by importing building and floor plans into *RingMaster*, defining RF obstacles and quality of coverage (traffic engineering parameters) you want for specific RF coverage areas.

A network plan is a repository for all hardware, site and configuration details for a single or multi-site network. This information is stored on your *RingMaster Services* server. You may have individual network plans for networks in multiple countries, in which case regulatory rules on channels, power levels, etc. are different. You may have more than one Network Plan to accommodate these differences or you can choose to have one plan with multiple sites.

Each network plan may have a number of sites (campuses or cities) in which there are one or more buildings and associated floors, and possibly Outdoor Areas. You should create a Network Plan name that is familiar to your IT team.

To create a network plan:

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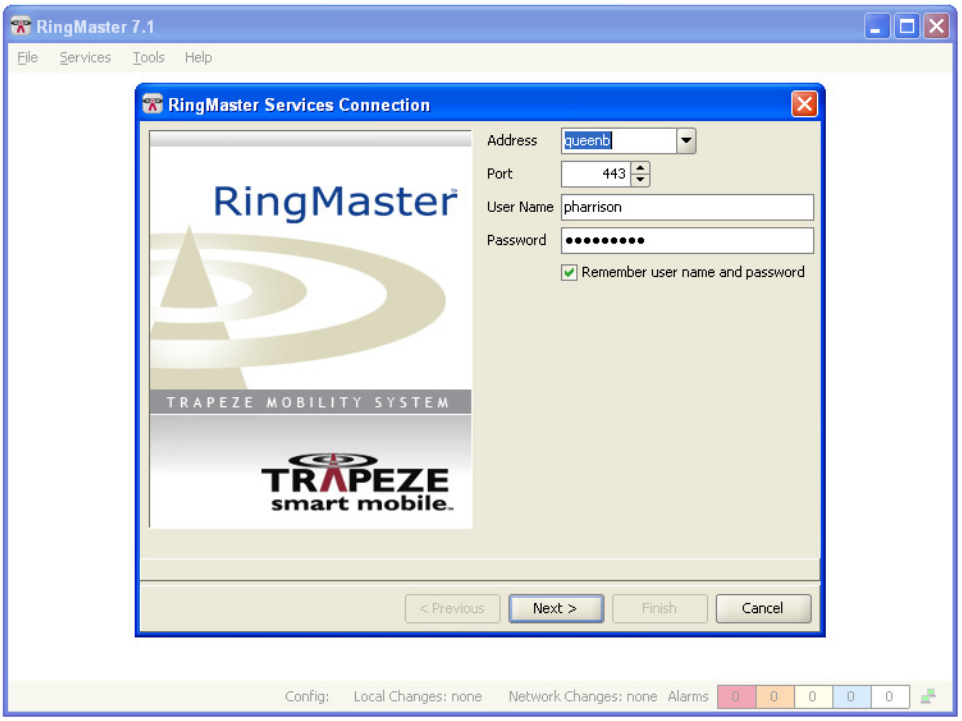
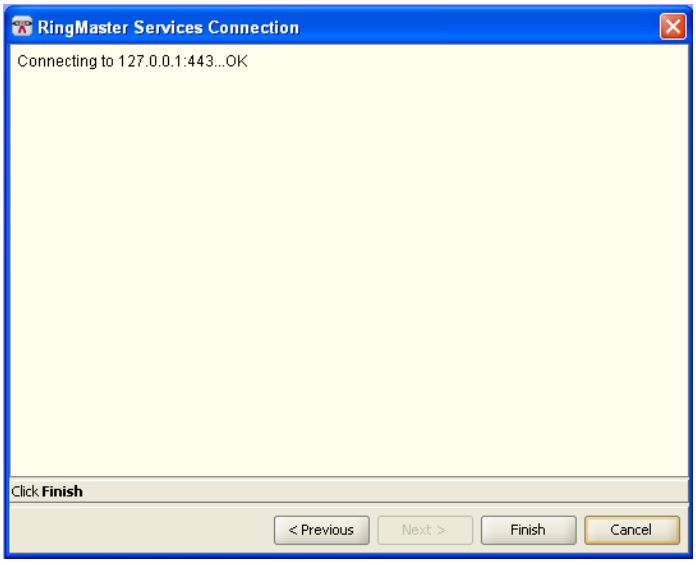
1. Connect to a host running *RingMaster Services*. When you start *RingMaster*, the main window and **RingMaster Services Connection** dialog box appear.



2. In the **RingMaster Services Connection** dialog box, enter the IP address of a host running *RingMaster Services*, optionally enter a user name and password, and click **Next**.
   If *RingMaster Service* is installed on the same machine as *RingMaster*, enter 127.1.0.1 as an IP address. This is a standard IP loopback address.
3. You will see the dialog below as the connection is approved and made.



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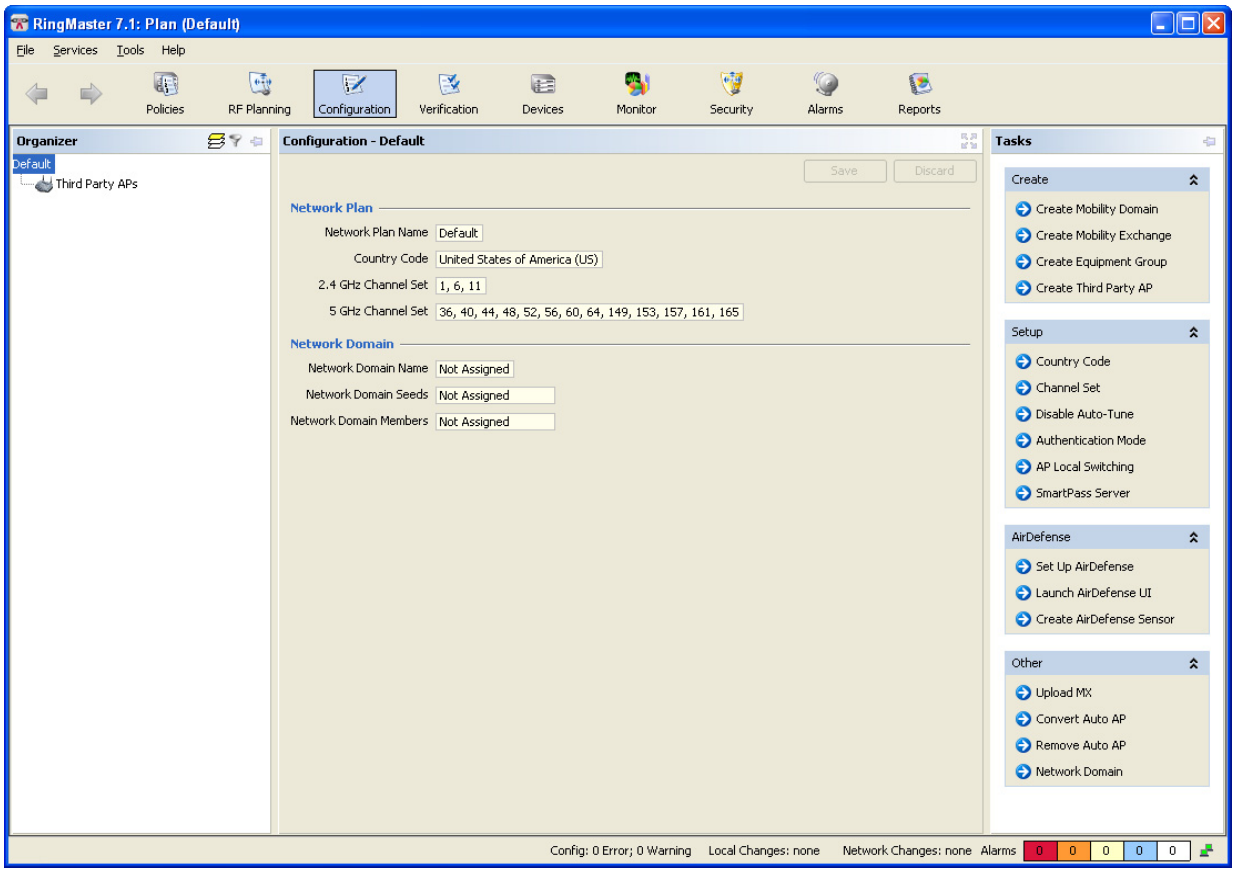
4. After a connection is established to a *RingMaster Services* host, you see the **RingMaster Client Main Window** below with a network plan named **Default** in the **Organizer** panel.



5. Select **Services > Plan Management** from the **RingMaster Client Main Window** menu bar. The **RingMaster Services Plan Management** page is displayed in your default browser. The **New Plan** page is displayed by default.
6. In the **Network Plan Name** field, type a name for your network plan — in the example above we have used the name **DocPlan**. For consistency, the network plan name **DocPlan** is the plan name used in later illustrations in this and other guides in the *RingMaster 7.4* documentation suite. You can use 1 to 60 alphanumeric characters with no spaces, tabs, or any of the following — slash (/), backslash (\), quotation marks (“ ”), asterisk (*), question mark (?), angle brackets (< >), or vertical bar (|).
7. From the **Country Code** pull-down list, select a country where the network is deployed.

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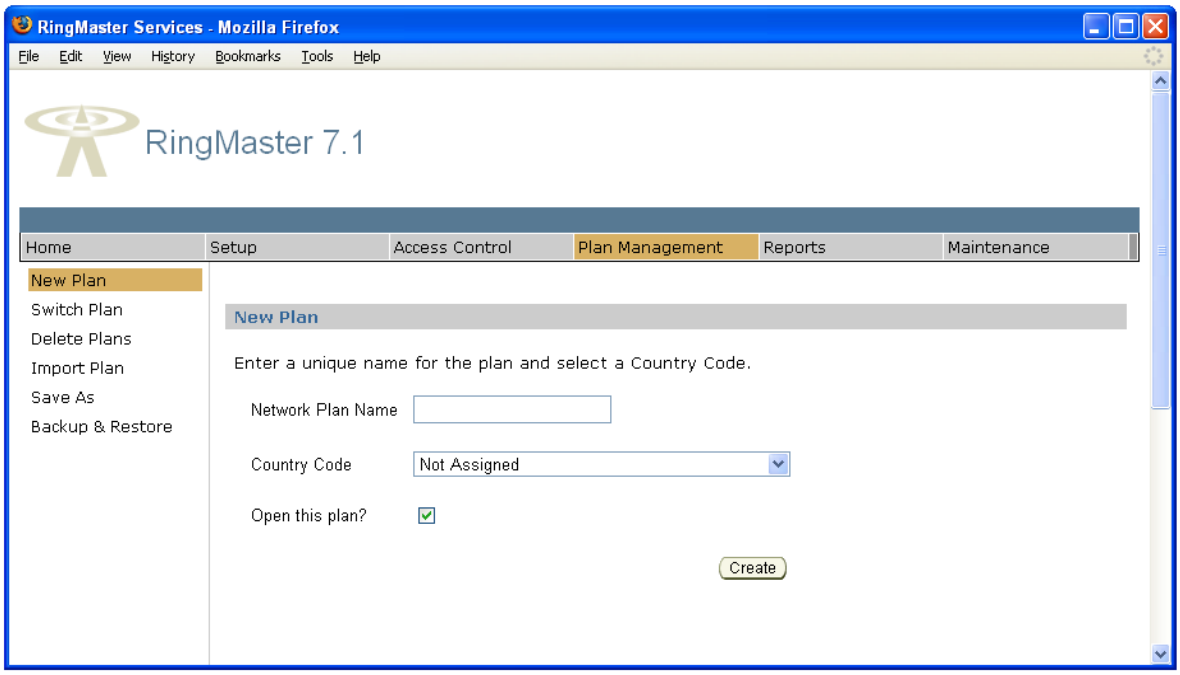
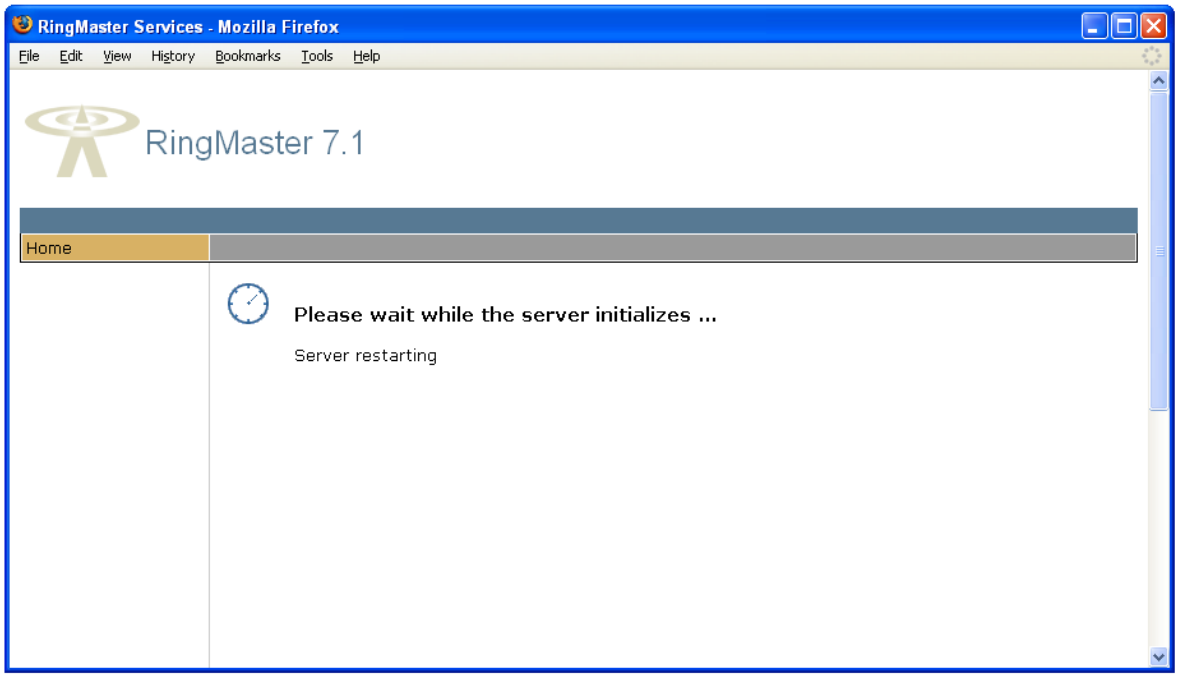
8. Select the **Open this plan?** check box to open a plan in *RingMaster*.



9. Click **Create** to create this new network plan.
10. Wait while the server initializes:


RingMaster Services - Mozilla Firefox
File Edit View History Bookmarks Tools Help
RingMaster 7.1
Home
Please wait while the server initializes ...
Server restarting

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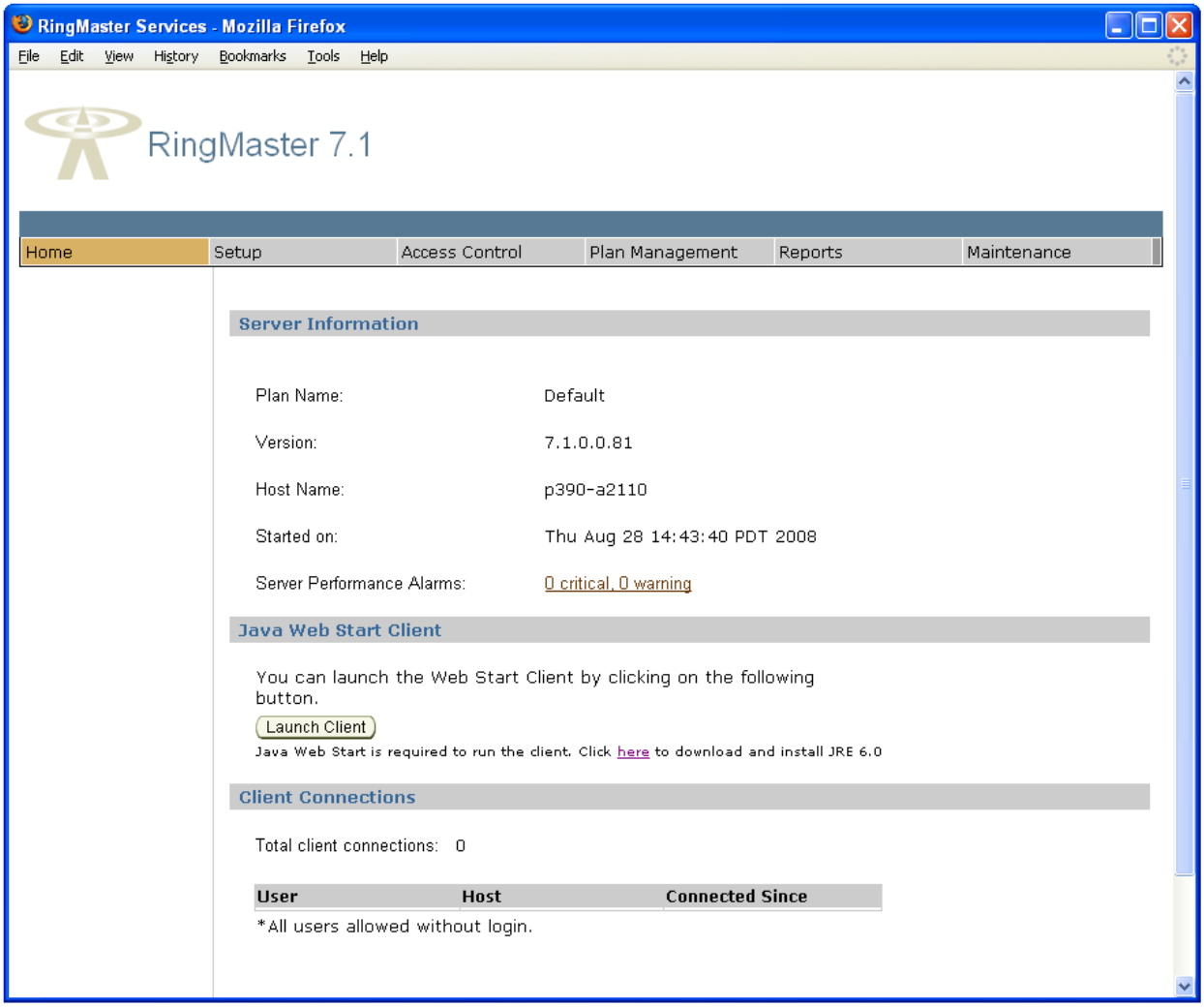
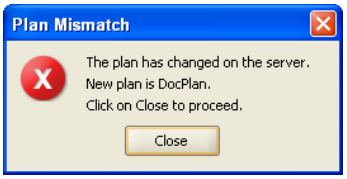
11. The Server information is displayed.



After a short time, the client you started in step 8 receives a notification that the plan has changed.



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Click **Close**, then reconnect using the main window **File** menu **Connect** item:

12. The **RingMaster Services Connection** dialog is displayed.

Click Next and to display the RingMaster Client Main Window with DocPlan as the active network plan.

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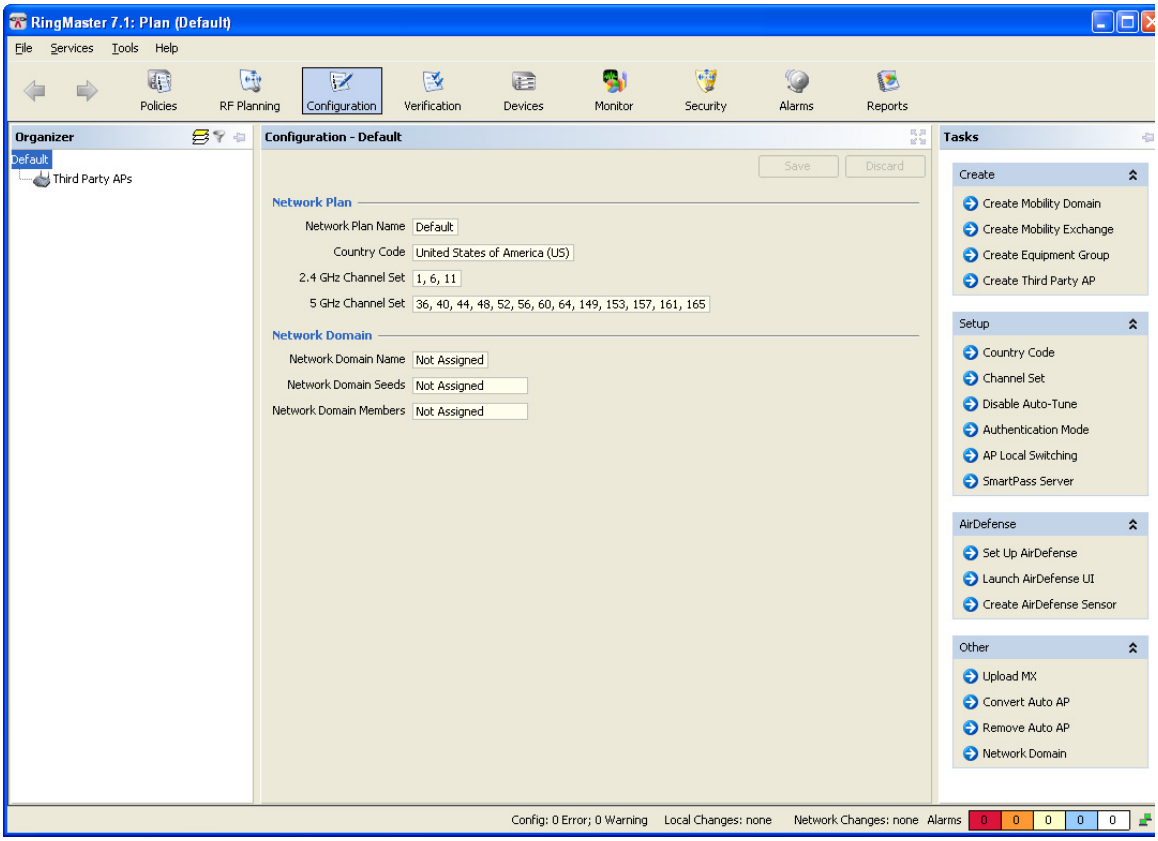
Example Plan “DocPlan”

After creating a network plan and adding basic information to create a wireless network, you can add sites, buildings, and outdoor wireless networks using *RingMaster* tools described in detail in this Guide.

You can import floor plans and create coverage areas even if you do not have a planning license. However, a planning license is required to create RF obstacles, compute and place equipment, assign radio channels, and optimize power settings.

Example dialog box entries used to create the illustrations in this guide will add to the network plan named **DocPlan** shown in the **Organizer** panel below.



Starting Network Planning

The following are three techniques you can use to start your wireless network:

- RF Auto-Tuning — This technique lets you use default auto tuning features to select power and channel settings for RF signals in your RF coverage area. You upload MXs into RingMaster, configure APs, enable RF Auto-Tuning, and deploy.
- RF Auto-Tuning with Modeling — Like RF Auto-Tuning, this technique lets you set auto tuning features to adjust power and channel settings for providing RF signals to a coverage area. You can enhance auto tuning feature by providing modelling information for a geographic location. By providing information about buildings and floors, you add details into RingMaster that allow you to visualize a network’s topology and thus provide monitoring at a site.
- RF Planning — This is a technique you use to create a network plan providing powerful monitoring and visualization benefits. Unlike RF Auto-Tuning or RF Auto-Tuning with Modelling, you do not rely on the auto tuning feature. Instead, you fully model a geographic location with information about floors and specify RF coverage areas and RF obstacles.

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RF Auto-Tuning

You perform the following steps when using the RF Auto-Tuning technique:

- Physically place MXs and the APs in desired locations.
- Upload an MX configuration and deploy it.
- Enable the RF Auto-Tuning feature.

This allows you to install MXs and APs and observe how a network operates. An RF Auto-Tuning plan is best for networks containing fewer APs.

RF Auto-Tuning with Modeling

To use RF Auto-Tuning with Modelling techniques, you add to the RF Auto-Tuning technique by providing geographical modelling for buildings, floors, and RF coverage areas. You add RF obstacle information for obstacles like concrete walls, windows, and elevator shafts that affect attenuation (the quality of RF signals emitted from and received by the APs). By adding geographical modelling, you manage a network in the context of geographical information. For example, you can manage a network viewed overlaid on a floor plan rather than managing an abstract logical group of MXs and APs.

RF Planning

To perform RF Planning, you provide information about your buildings by importing *AutoCAD* DXF™, *AutoCAD* DWG, JPEG, or GIF floor plan files into *RingMaster*. As you import floor plans, you modify them to add or remove RF obstacles. You define RF obstacles by specifying an attenuation factor in decibels for each obstacle. In addition, *RingMaster* includes a library of attenuators for building obstacles. The library includes doors, walls, ceilings, and other physical obstructions you select. *RingMaster* factors in the impact of these objects on Radio Frequency (RF) signals flowing through a given site.

If a network contains third-party or pre-installed APs, enter information for these APs so *RingMaster* takes these APs into account when calculating placement (and optionally, channel and power settings) of Juniper APs.

Use of this technique has the following benefits:

- Instead of making a “best guess” of how many APs are required for a desired coverage and where they should be placed, RingMaster calculates how many APs you need and specifies their locations to provide optimum performance.
- You generate a deployable work order to help installers place MXs and APs.
- You automatically receive a deployable configuration that includes optimum power and channel settings.
- You enjoy more accurate monitoring options and network visualization based on the additional geographic modeling information loaded into RingMaster.

Recommended Planning Method

Detailed network plans provide better management and monitoring of a network. However, there are other requirements you should consider. We recommend using RF Auto-Tuning if you are installing APs without consideration of blanket coverage, throughput concerns, or the number of users for whom services are provided. RF Auto-Tuning is ideal for small areas, such as coverage that only requires a few APs or widely dispersed areas in a building, such as conference rooms.

You use RF Auto-Tuning with Modelling techniques where you want to improve monitoring of a wireless network in terms of buildings, floors, or coverage areas. You may locate inaccurate or incomplete building and floor plans (perhaps only a JPEG file), but with geographic modelling of your site you improve your ability to visualize your network.

You can use RF Planning tools provided in *RingMaster* to initially plan work. You may have multiple constituencies of users to consider. For example, users who are mobile and wireless have specific throughput and bandwidth needs. One group of users might be mobile and require high throughput performance, while another group is more stationary and requires less throughput. You might be planning future capacity and need to add detailed information about your site to plan for the future.

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The table below provides guidelines to help you determine an appropriate planning technique for your organization.

Table 1– 1. Selecting Appropriate Planning Techniques

Question	If yes, use	If No, use
Do I have adequate time to add geographic modelling and RF obstacle information?	RF Auto-Tuning with Modelling	RF Auto-Tuning
Can I locate accurate building and floor plans?	RF Planning or RF Auto-Tuning with Modelling	RF Auto-Tuning with Modelling
Do I need to plan for capacity of users or quality of coverage (traffic engineering concerns) for certain users?	RF Planning	RF Auto-Tuning or RF Auto-Tuning with Modelling
Do I need to visualize coverage accurately?	RF Planning	RF Auto-Tuning or RF Auto-Tuning with Modelling
Do I need to locate users?	RF Planning or RF Auto-Tuning with Modelling	RF Auto-Tuning
Do I need to locate rogue APs?	RF Planning or RF Auto-Tuning with Modelling	RF Auto-Tuning
Do I want to better monitor my wireless network in terms of buildings, floors, or coverage areas?	RF Planning or RF Auto-Tuning with Modelling	RF Auto-Tuning

If RF Planning does not fit your requirements now, you can use it in the future when there is a need, time, and floor plans. You can leverage data in RF Auto-Tuning and convert RF measurements to configured baseline values for planning.

RF Plan Optimization

Optimization involves importing of RF measurement data into an RF model to improve the accuracy of the model. A network plan contains configuration settings to determine the performance of a wireless network. Optimization of an RF model leads to a more successful RF plan. This plan provides an accurate visualization of RF coverage, statistics for monitoring, and an ability to accurately plan for and improve network performance.

You optimize a network based on user and network statistics gathered from:

- Monitoring data in RingMaster
- A site survey

RF measurement data you gather in *RingMaster* is used to optimize the RF model of a floor. You can make configuration changes in the software to improve signal strength and coverage for groups or individuals, modify AP locations, or add additional equipment to your wireless network if statistics indicate your network has outgrown the support provided by the current deployment of MXs and APs. You can import RF measurement data based on a site survey done outside of *RingMaster*. Refer to **Optimizing an RF Coverage Model** for general guidelines about performing a site survey.

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RingMaster's RF Planning Wizard

RF planning is done using site information provided to *RingMaster*. By defining network plans, sites, buildings, floors and outside areas, you provide *RingMaster* information regarding a network and its geographical and/or organizational boundaries. For wireless networks, Radio Frequency (RF) Planning is done first. This involves configuring RF coverage areas, and adding RF obstacle and third-party AP information.

Creation of sites, buildings, outdoor areas, locating and adding equipment and making configuration choices is all done using a series of dialog boxes that function as a "wizard" to guide you in the process of planning a WLAN for your organization. This wizard guides you through RF Planning as described in this chapter. There are optional ways of performing these planning functions available "outside" of the wizard for additions, selections and changes as described in later chapters of this Guide.

The major steps in RF Planning as directed by the RF Planning Wizard are:

- **Adding Site Information**
- **Importing or Drawing Floor Details**
- **Creating RF Obstacles**
- **Creating Coverage Areas**
- **Compute and Place**
- **Channel Assignment**
- **Compute Optimal Power**
- **Steps After Using RF Planning Wizard**

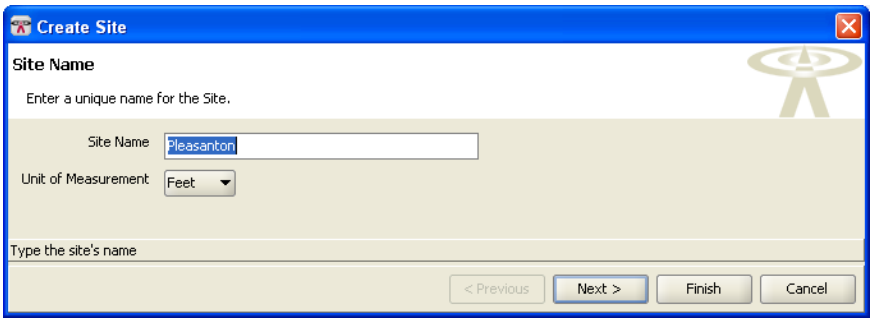
Adding Site Information

Site information includes information about an overall campus, individual buildings, and individual floors. You describe attenuation characteristics in these locations and specify the traffic engineering needs (bandwidth and reliability) of users.

RingMaster commits your work into a network plan only when you click **Finish**, not when you click **Next**.

To create a site:

1. Click **RF Planning**.
2. In the **Organizer** panel, click the network plan icon.
3. Select **Create Site** in the **Tasks** panel. The **Create Site** dialog prompts you for information about the new site.



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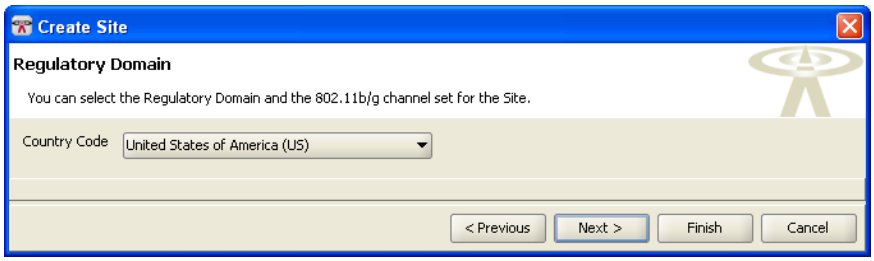
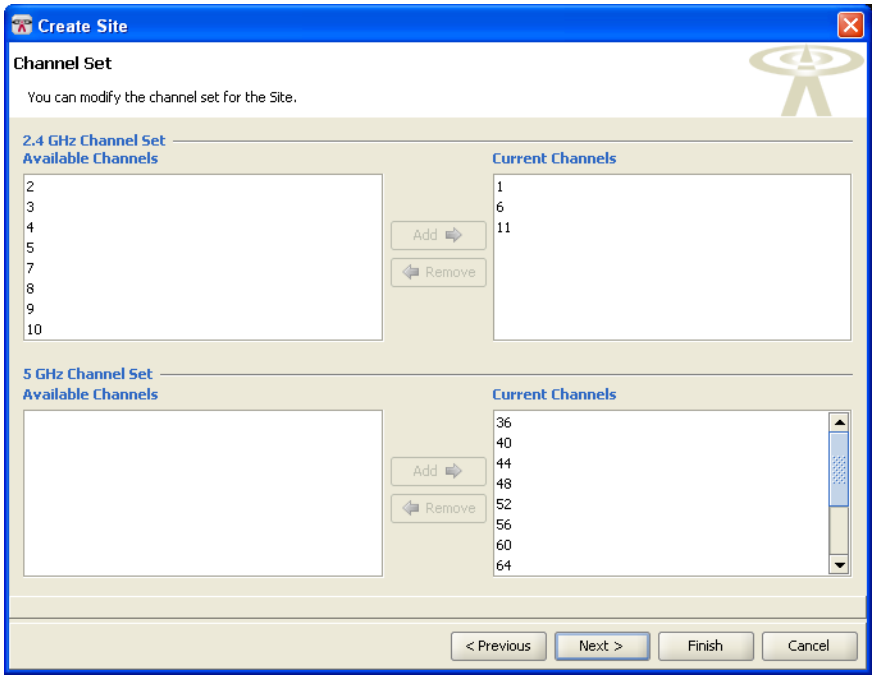
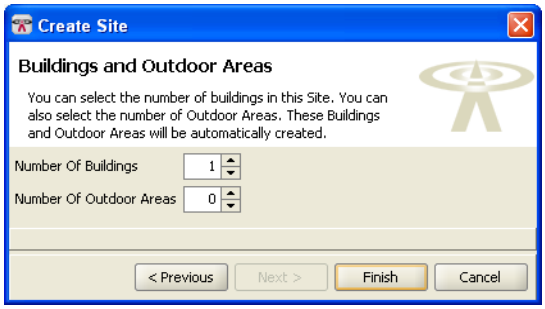
4. In the **Site Name** field, type a name for the site (1 to 80 alphanumeric characters, with no spaces or tabs), select feet or meters for units with the pull-down menu, and click **Next**.



5. In the **Regulatory Domain** dialog, select from the **Country Code** pull-down menu. Click **Next**.



6. In the **Channel Set** dialog, add and delete channels to **Current Channels** to select a set of operating channels for 2.4 GHz and 5 GHz you plan to use and click **Next**.


Create Site
Buildings and Outdoor Areas
You can select the number of buildings in this Site. You can also select the number of Outdoor Areas. These Buildings and Outdoor Areas will be automatically created.
Number Of Buildings
1
Number Of Outdoor Areas
0
< Previous
Next >
Finish
Cancel

7. In the **Building and Outdoor Areas** dialog**,** select a **Number Of Buildings** and **Number Of Outdoor Areas**. When you specify the number of buildings and Outdoor Areas for a site,

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RingMaster creates buildings and Outdoor Areas using default settings. You can edit buildings or Outdoor Areas that *RingMaster* creates.

This step is optional, as buildings and outside areas can be added later using **Tasks** panel selectable items.

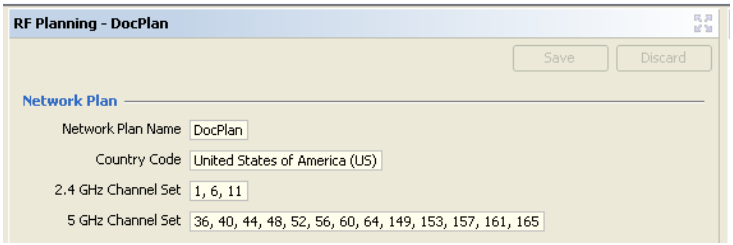
Click **Finish** to save settings and close the dialog.

Customizable Channel Set

The channel set used for RF Planning is customizable for both bands — 2.4 GHz and 5 GHz.

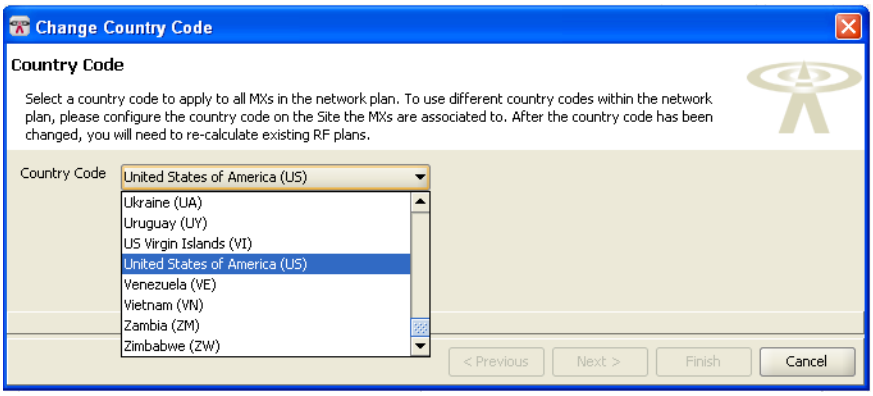
- The 2.4 GHz channel set is automatically converted into a new format when an old plan is opened. When a new plan is created, default channels are set in the channel set.
- The 5 GHz channel set is automatically added when a new plan is created or opened in 7.4.x. It will contain all the available channels for a given country.

You are allowed to select valid channels in a country into a channel set. On the Network Plan level, both channel sets are displayed.



You can customize the channel set via the following tasks:

The **Country Code** dialog allows you to select a country using a pull-down menu:


Change Country Code
Country Code
Select a country code to apply to all MXs in the network plan. To use different country codes within the network plan, please configure the country code on the Site the MXs are associated to. After the country code has been changed, you will need to re-calculate existing RF plans.
Country Code
United States of America (US)
Ukraine (UA)
Uruguay (UY)
US Virgin Islands (VI)
United States of America (US)
Venezuela (VE)
Vietnam (VN)
Zambia (ZM)
Zimbabwe (ZW)
< Previous
Next >
Finish
Cancel

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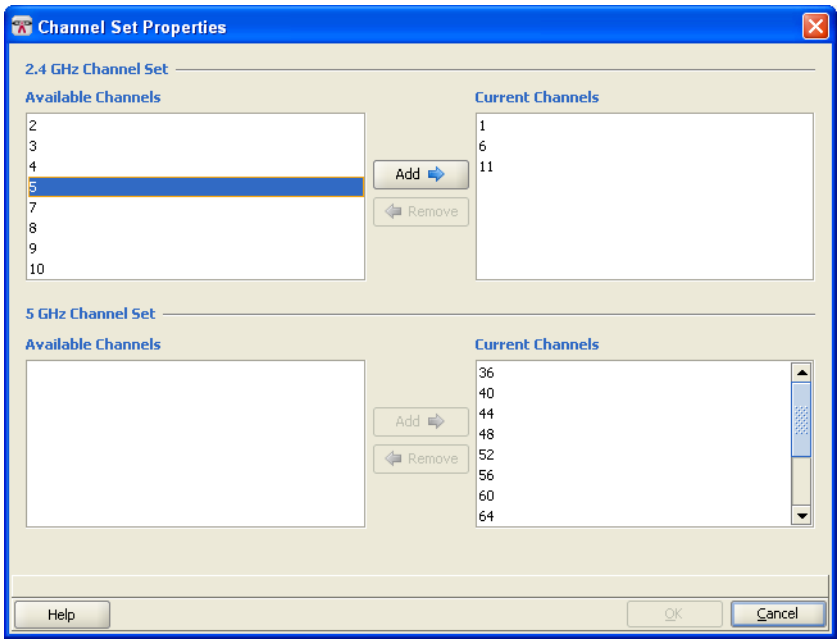
The **Channel Set Properties** dialog allows you to modify channels.



A Site has the same display channels in its **Site Properties** dialog, allowing you to edit a Channel Set. Make desired changes and click **OK**, or click **Cancel** if no changes are made.

The following tasks in RF Planning utilize the new channel set:

- **Compute and Place Task**
- **Channel Assignment Task**

Importing or Drawing Floor Details

In *RingMaster 7.4*, starting any of the tasks on an **Organizer** panel tree floor icon starts the RF Planning wizard to help you complete planning steps in the proper sequence. Clicking to import a floor plan starts the RF Planning wizard, whose use is always recommended.

To add information for a floor, import a drawing of the floor or use the graphics tools in *RingMaster* to draw the floor. After importing or drawing a floor, specify RF characteristics of the floor and the attenuation of obstacles such as walls, doors, windows, etc. The attenuation of an object indicates how the object affects an 802.11 radio signal. *RingMaster* uses attenuation information when calculating how many APs are needed and where to place them to provide desired wireless coverage. The following sections describe how to import or draw a floor.

Import Drawing

Before importing a drawing into *RingMaster*, you should follow the procedures in the section **Preparing a Drawing Before Importing**.

To import a floor drawing:

1. click **RF Planning**.
2. In the **Organizer** panel, expand a building, then click on the name of a floor to import its drawing. The floor layout appears in the **Content** panel.
3. In the **Tasks** panel, under **RF Planning**, select **Import Layout**.

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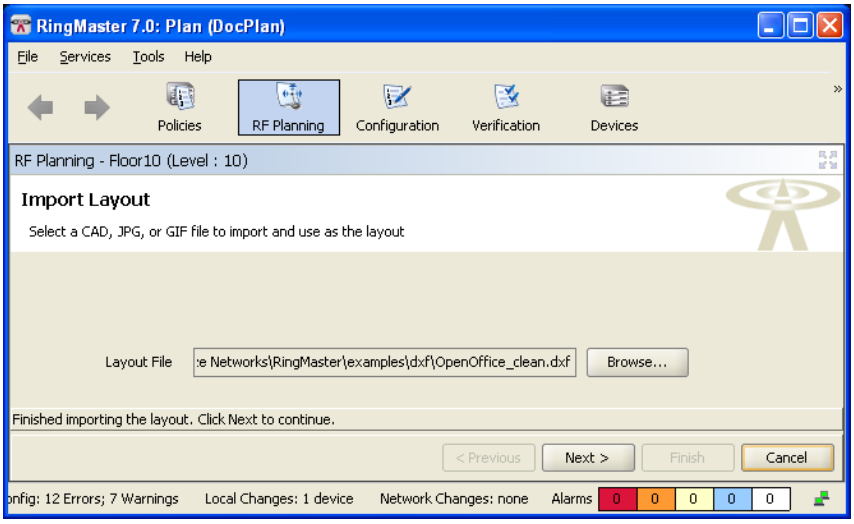
4. You see the following dialog:



After navigating to the directory containing the drawing, select it and click **Next**.

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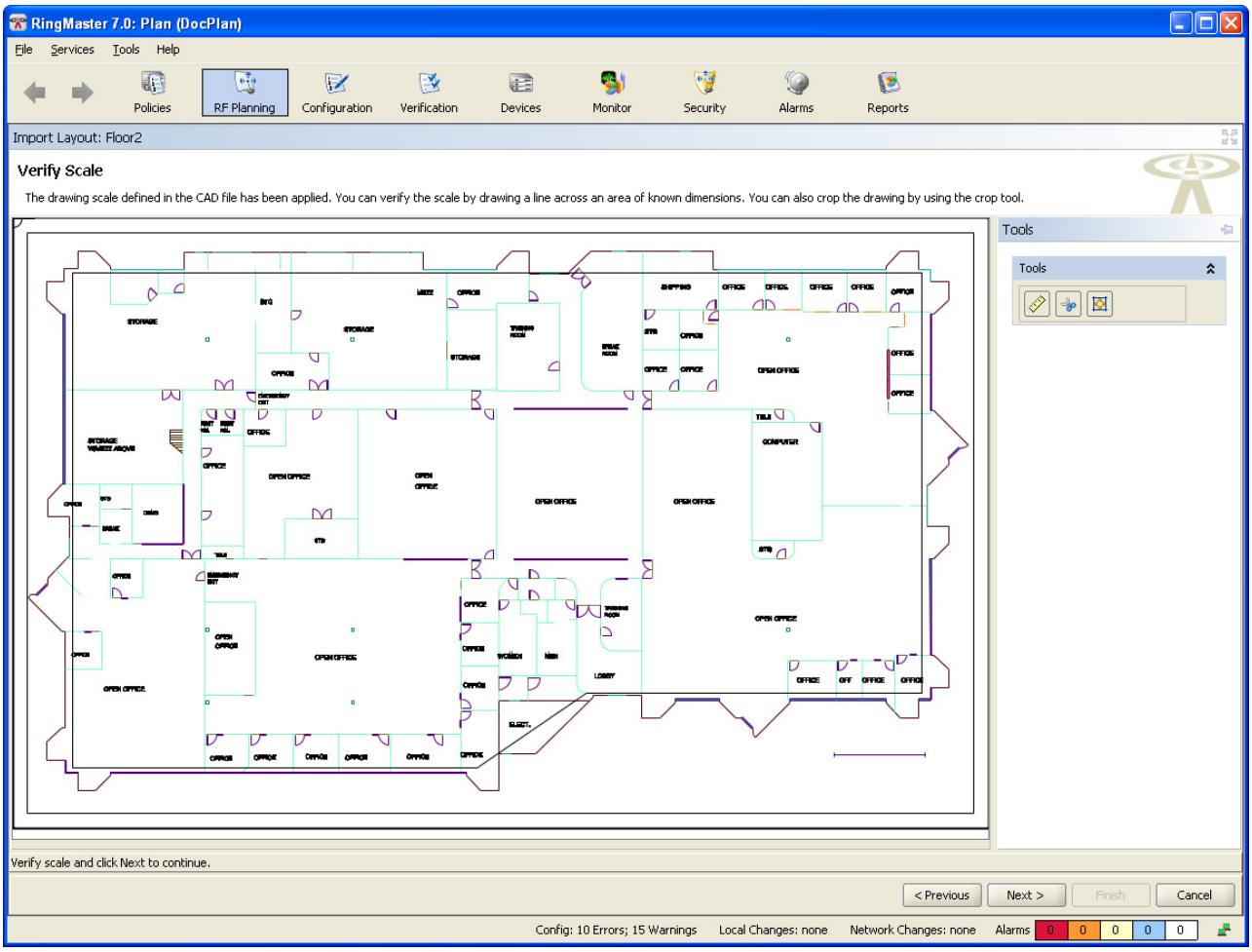
5. You can now select the scaling of the drawing.



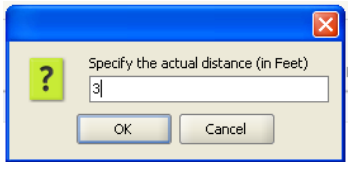
Adjusting the Scale of a Drawing

If you imported a DWG or DXF drawing, you *must* adjust the scale of the drawing because the units used in these drawings might not have a one-to-one correspondence to meters and feet. To adjust the scale of the drawing, you draw a line between two points of known distance and adjust the measurement.

You can accept the scale defined in the CAD file by clicking **Next**, or you can set it manually as described below.

To adjust the scale manually:

1. Display the floor plan in the **Content** panel.
2. Drag to create a line between two points. A dialog box appears.



3. In the dialog box, type the actual distance between the two points.
4. Click **OK** then click **Next**.

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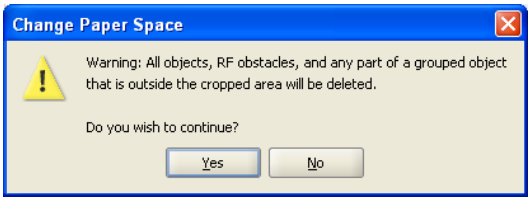
Cropping a Drawing

You can crop a drawing to remove unneeded space and objects around a floor. For example, if a drawing includes parking lot information, you can remove the parking lot by cropping.

All objects outside of the selected area are permanently removed. The drawing can be re-imported to correct this problem, but all planning must be re-done.

To crop a drawing:

1. Display a floor plan in the **Content** panel.
2. Click on the **Tools** panel.
3. Click and diagonally drag the cursor over the area you want to keep.
4. Release the mouse button. A warning is displayed.


Change Paper Space
Warning: All objects, RF obstacles, and any part of a grouped object that is outside the cropped area will be deleted.
Do you wish to continue?
Yes
No

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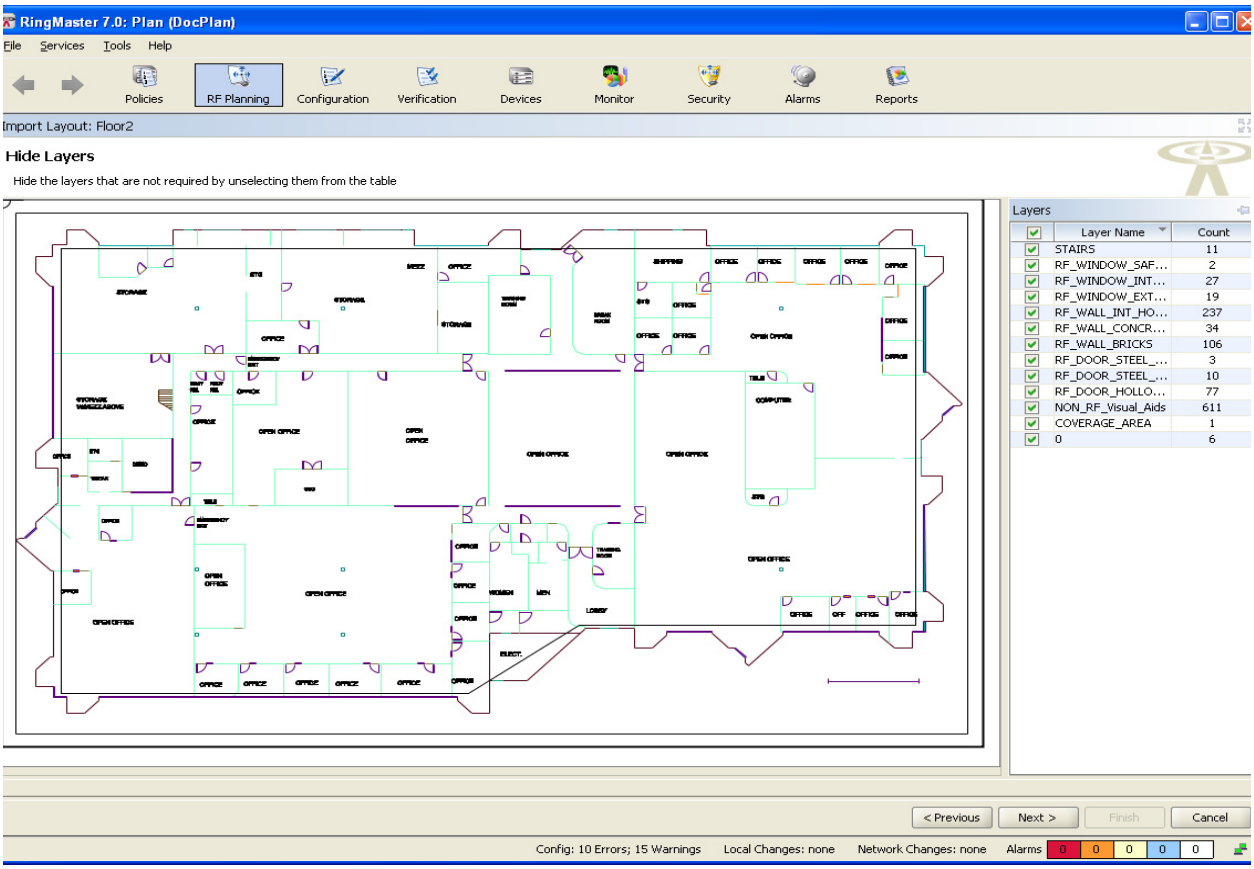
5. To complete the crop, click **Yes**. To cancel a crop request, click **No**. If you click **Yes**, all objects and space outside the area you selected are removed and the image is resized to fill the space.



Hiding Layers

Most drawings contain multiple layers of information. *RingMaster* allows you to hide, add and/or delete layers. You can add and remove objects and move objects from one layer to another. For RF planning, you can convert existing objects into RF obstacles and add new RF obstacles. Generally, only some layers contain details relevant to RF planning. *RingMaster* allows you to hide layers to simplify a drawing. *RingMaster* performs RF calculations with information in visible layers only. Each drawing that you import into *RingMaster* has a layer **0** that contains information created by *RingMaster*. *RingMaster* requires layer **0** to be visible when calculating RF coverage or performing rogue detection.

For best performance and simpler planning, hide or remove unnecessary layers and remove unnecessary objects. The **Clean Layout** option automatically deletes all objects that meet the cleanup criteria, which you can modify. (See **Cleaning Up a Drawing**.) You also can select and delete individual objects.

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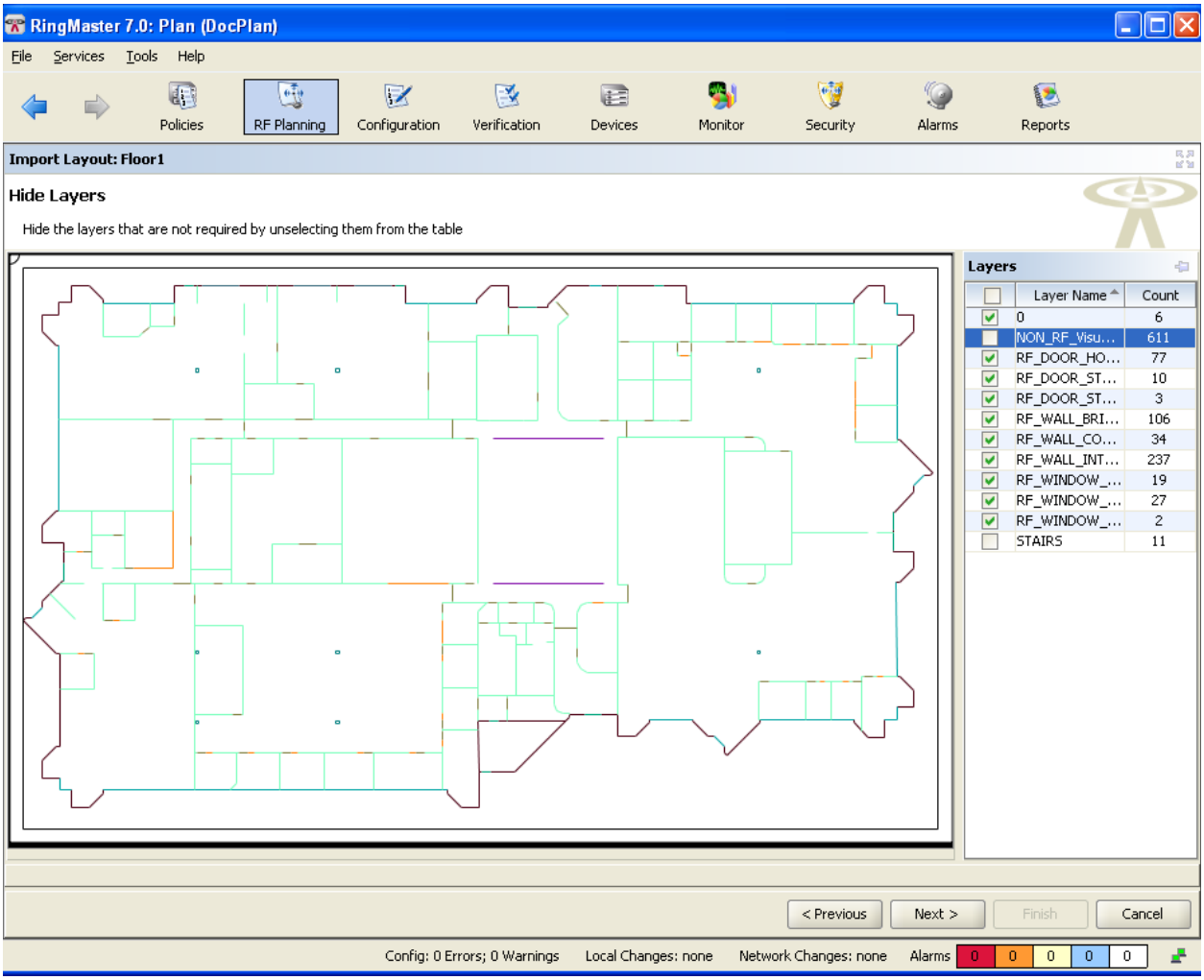
You now can hide unnecessary drawing layers by clearing the checkbox next to the layer name.



When you have hidden the layers you do not want to see, click **Next**. You can, optionally, perform functions described in **Working with Drawings**. When this process is completed, click **Next** to go to the **Continue Planning?** dialog.

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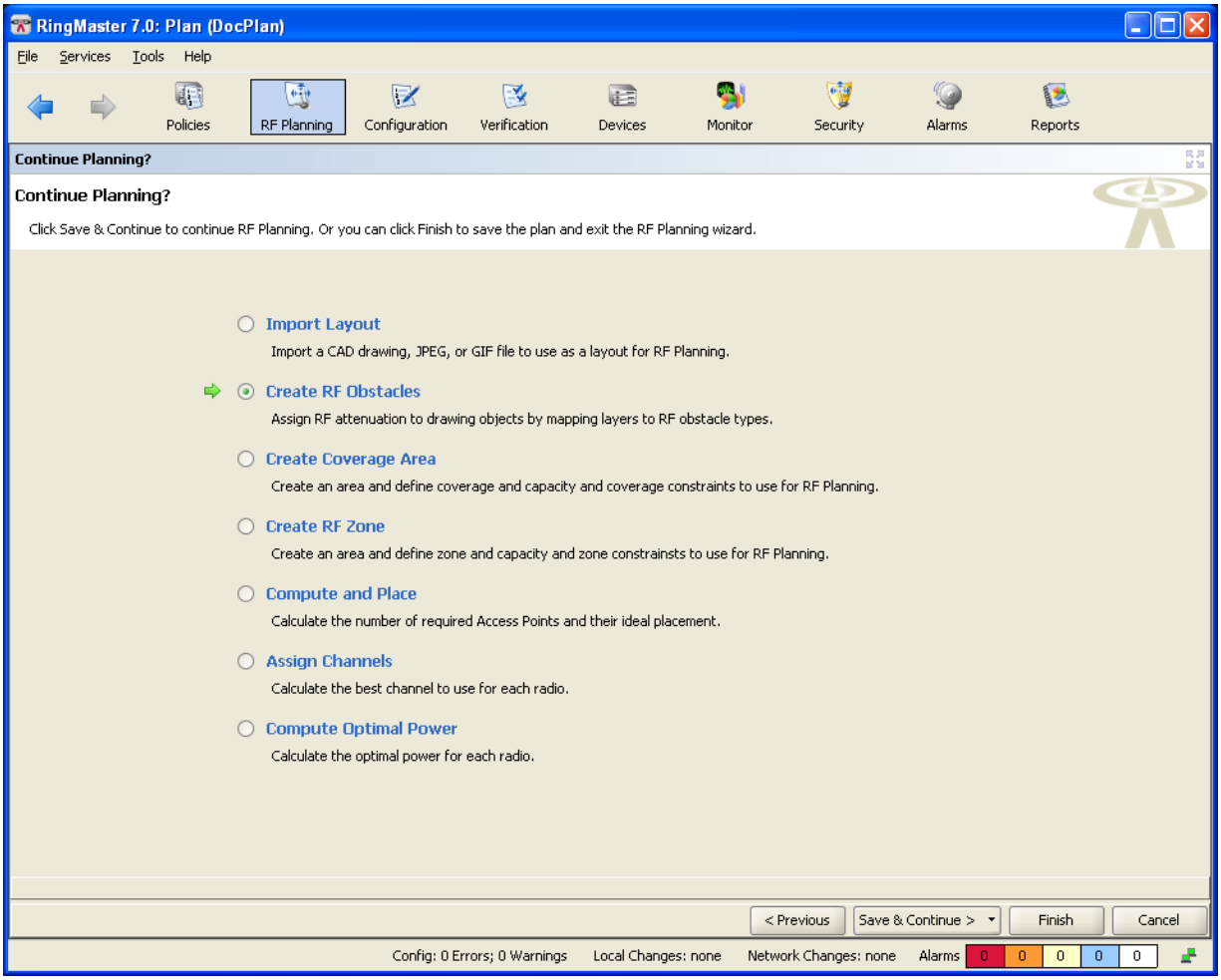
Continue Planning? Dialog

Clicking **Next** from the **Hide Layers** portion of the **Import Layout** wizard presents the **Continue Planning?** dialog:


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Policies
RF Planning
Configuration
Verification
Devices
Monitor
Security
Alarms
Reports
Continue Planning?
Continue Planning?
Click Save & Continue to continue RF Planning. Or you can click Finish to save the plan and exit the RF Planning wizard.
Import Layout
Import a CAD drawing, JPEG, or GIF file to use as a layout for RF Planning.
Create RF Obstacles
Assign RF attenuation to drawing objects by mapping layers to RF obstacle types.
Create Coverage Area
Create an area and define coverage and capacity and coverage constraints to use for RF Planning.
Create RF Zone
Create an area and define zone and capacity and zone constrainsts to use for RF Planning.
Compute and Place
Calculate the number of required Access Points and their ideal placement.
Assign Channels
Calculate the best channel to use for each radio.
Compute Optimal Power
Calculate the optimal power for each radio.
< Previous
Save & Continue >
Finish
Cancel
Config: 0 Errors; 0 Warnings
Local Changes: none
Network Changes: none
Alarms

You can click **Save and Continue** and you will proceed to **Create RF Obstacles** as noted by the arrow and the selected radio button, or you can click **Finish** to save the plan and exit the wizard.

Clicking on a radio button *other than* the one with the arrow takes you to that function "out of sequence" relative to the wizard.

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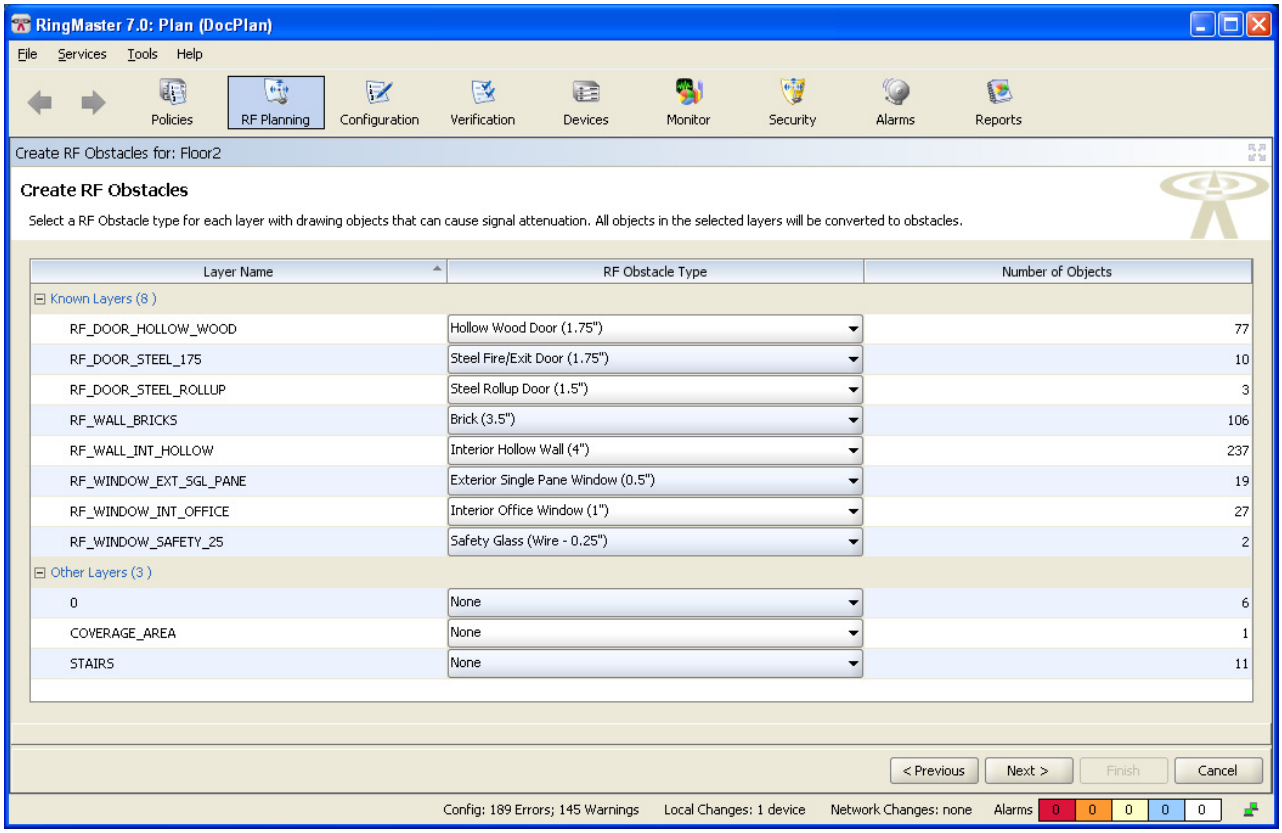
Creating RF Obstacles

If you click **Save and Continue** without changing the selected radio button, you see the **Create RF Obstacles** dialog.



Use the pull-down menus to select the characteristics of objects. The example above shows the selection of **RF WALL BRICKS** to be **Brick (3.5")**. Make selections and click **Next**. You will see a Progress dialog that shows when settings are 100% saved. Click **Next**.

RingMaster can automatically map a layer to a pre-defined **RF Obstacle Type**.

See **Tools > RF Obstacle Types Library**.

If you do not want to assign any obstacle to a layer at this point, set the **RF Obstacle Type** to **None** and the layer is skipped.

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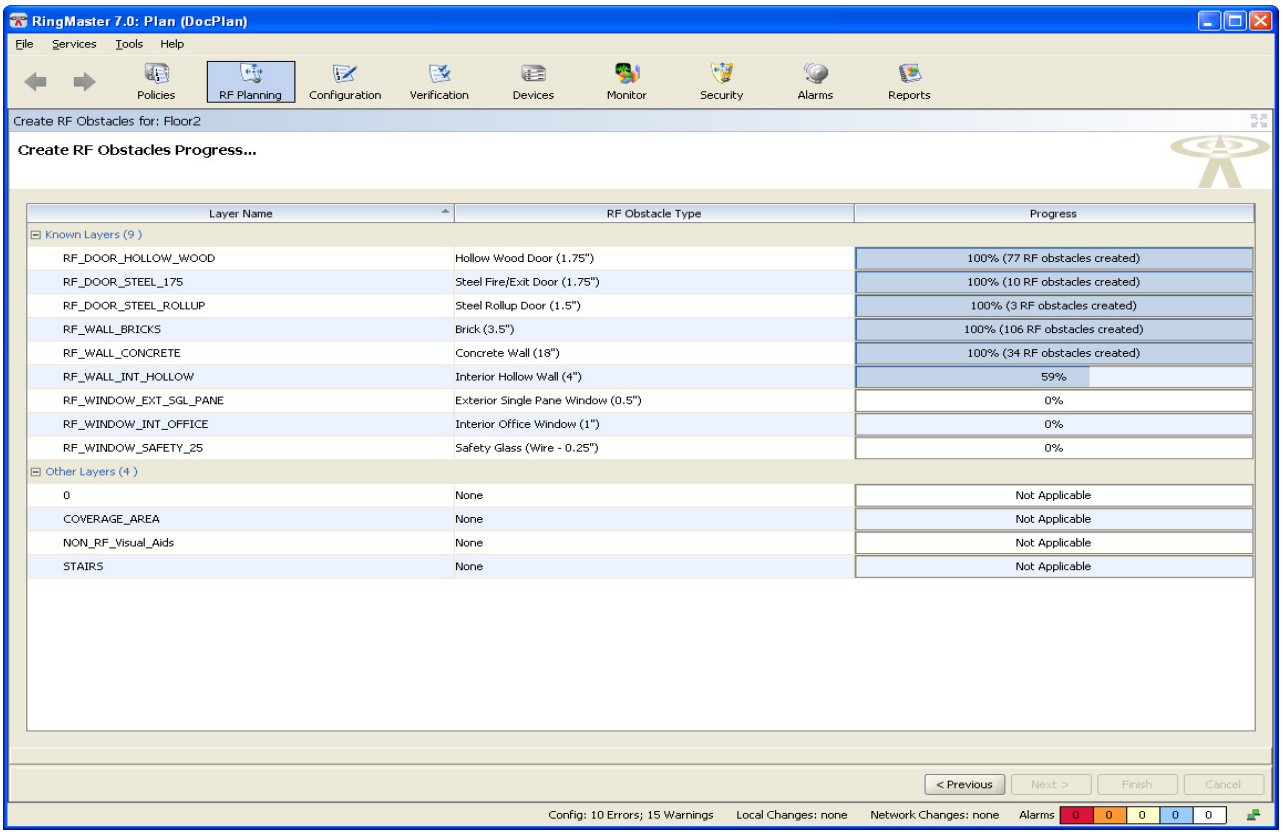
The progress of obstacle programming is displayed:



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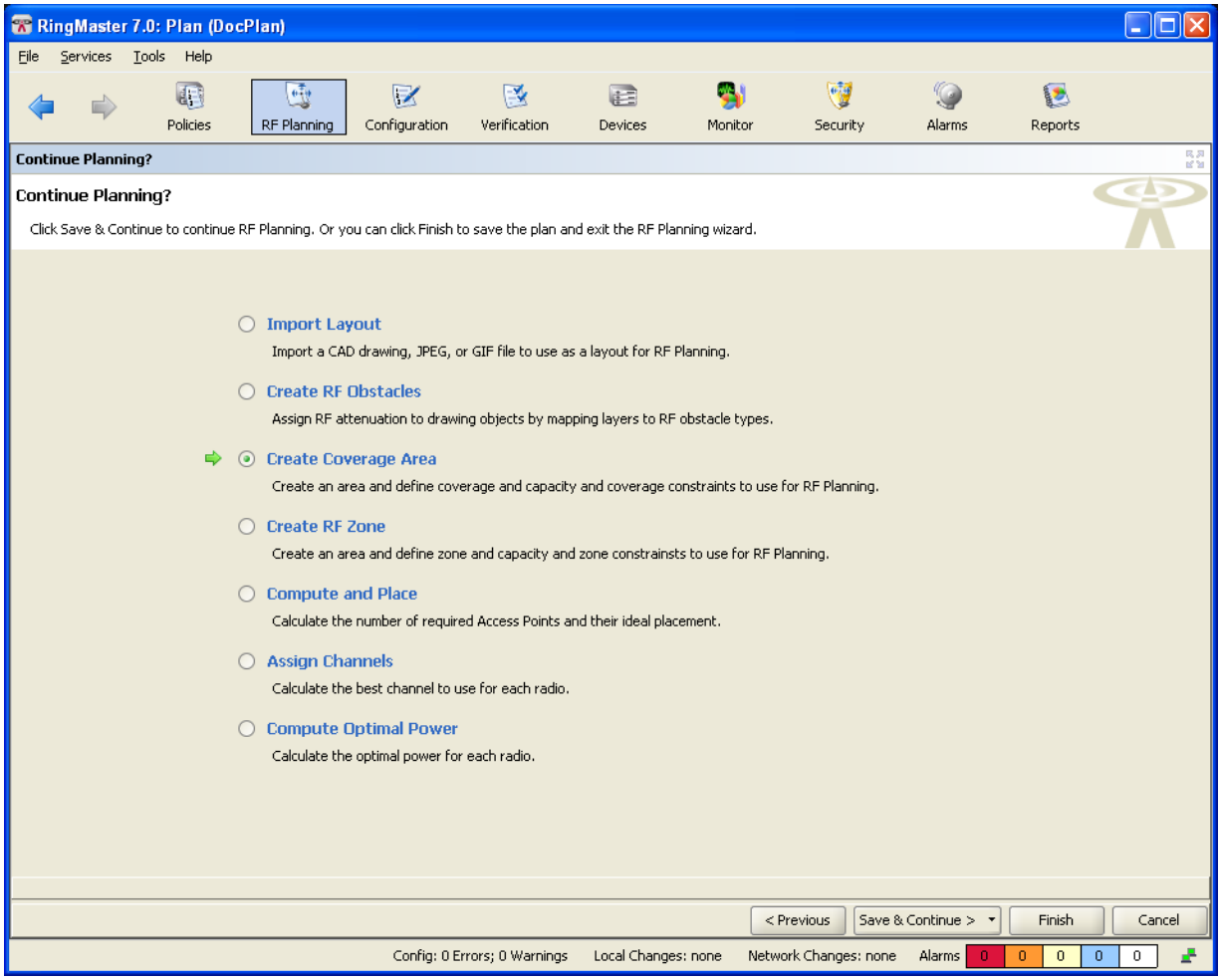
You once again see the **Continue Planning?** dialog, this time with an arrow pointing to the selected **Create Coverage Area** radio button. Click **Save and Continue**.


RingMaster 7.0: Plan (DocPlan)
File
Services
Tools
Help
Policies
RF Planning
Configuration
Verification
Devices
Monitor
Security
Alarms
Reports
Continue Planning?
Continue Planning?
Click Save & Continue to continue RF Planning. Or you can click Finish to save the plan and exit the RF Planning wizard.
Import Layout
Import a CAD drawing, JPEG, or GIF file to use as a layout for RF Planning.
Create RF Obstacles
Assign RF attenuation to drawing objects by mapping layers to RF obstacle types.
Create Coverage Area
Create an area and define coverage and capacity and coverage constraints to use for RF Planning.
Create RF Zone
Create an area and define zone and capacity and zone constrainsts to use for RF Planning.
Compute and Place
Calculate the number of required Access Points and their ideal placement.
Assign Channels
Calculate the best channel to use for each radio.
Compute Optimal Power
Calculate the optimal power for each radio.
< Previous
Save & Continue >
Finish
Cancel
Config: 0 Errors; 0 Warnings
Local Changes: none
Network Changes: none
Alarms
0
0
0
0
0

Creating Coverage Areas

RF coverage areas are areas in a network for which RF coverage is defined. As you configure an RF coverage area, you consider bandwidth requirements and the number of users. You define a coverage area on a floor plan using a coverage area drawing tool. Most shapes for a coverage area are possible.

However, the following restrictions apply:

- A shape where two sides intersect is **not permitted**.
- A shared coverage area with a partial intersection is not supported.

RingMaster supports sharing of coverage areas if one area is completely within a larger area. For example, you might want 802.11a and 802.11b coverage in a conference room that is part of a larger coverage area with 802.11a coverage. APs are shared only in the overlapped area.

When you draw a coverage area, it aligns to the grid to provide a whole number for width and height of the shape.

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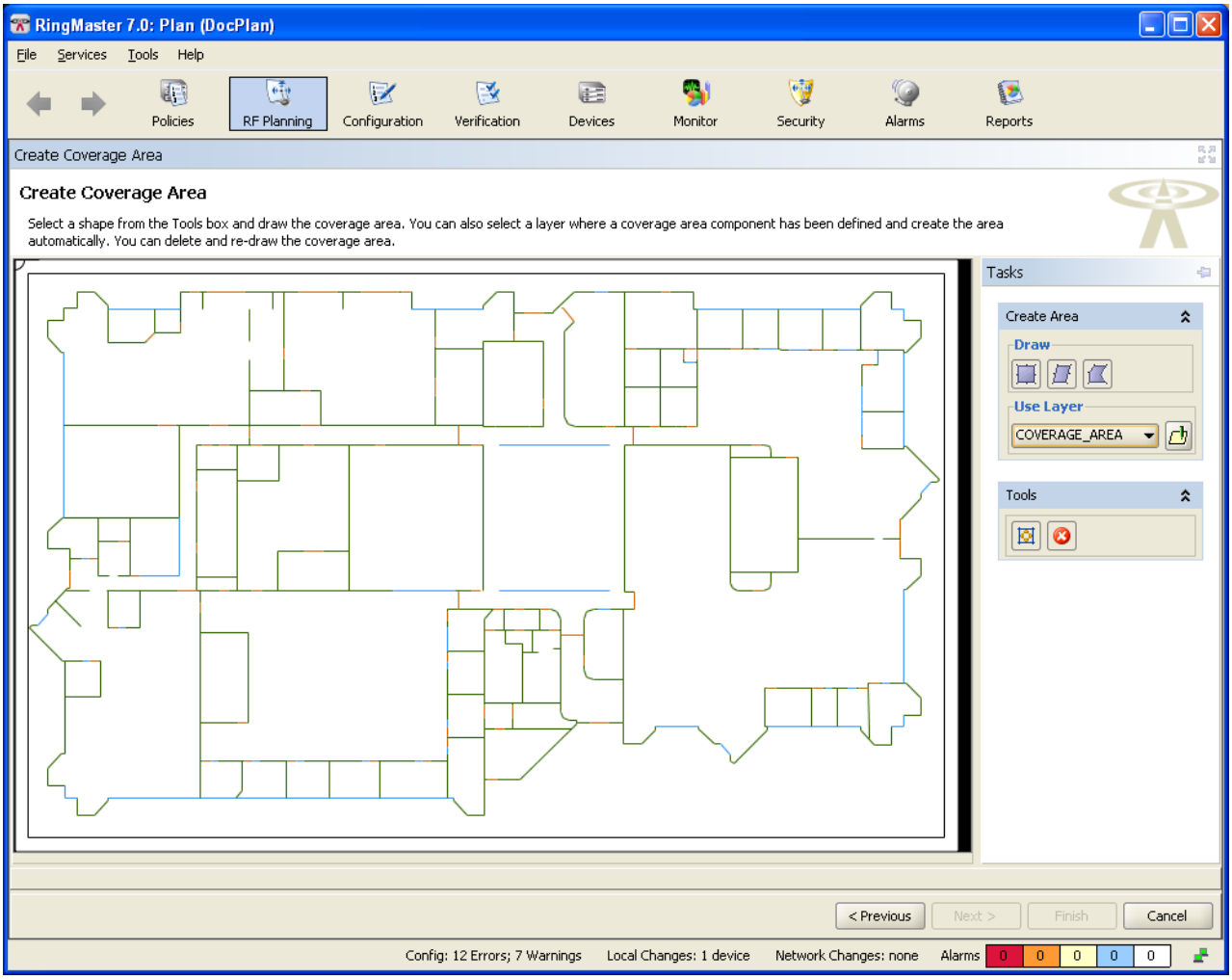
1. The **Create Coverage Area** dialog is displayed:



In the **Tasks** panel under **Create Area**, you can click on the icon to accept the default coverage area in the imported file or create a custom area as described below.

Drawing of custom areas is terminated via a right click, otherwise you may create an overlapping side.

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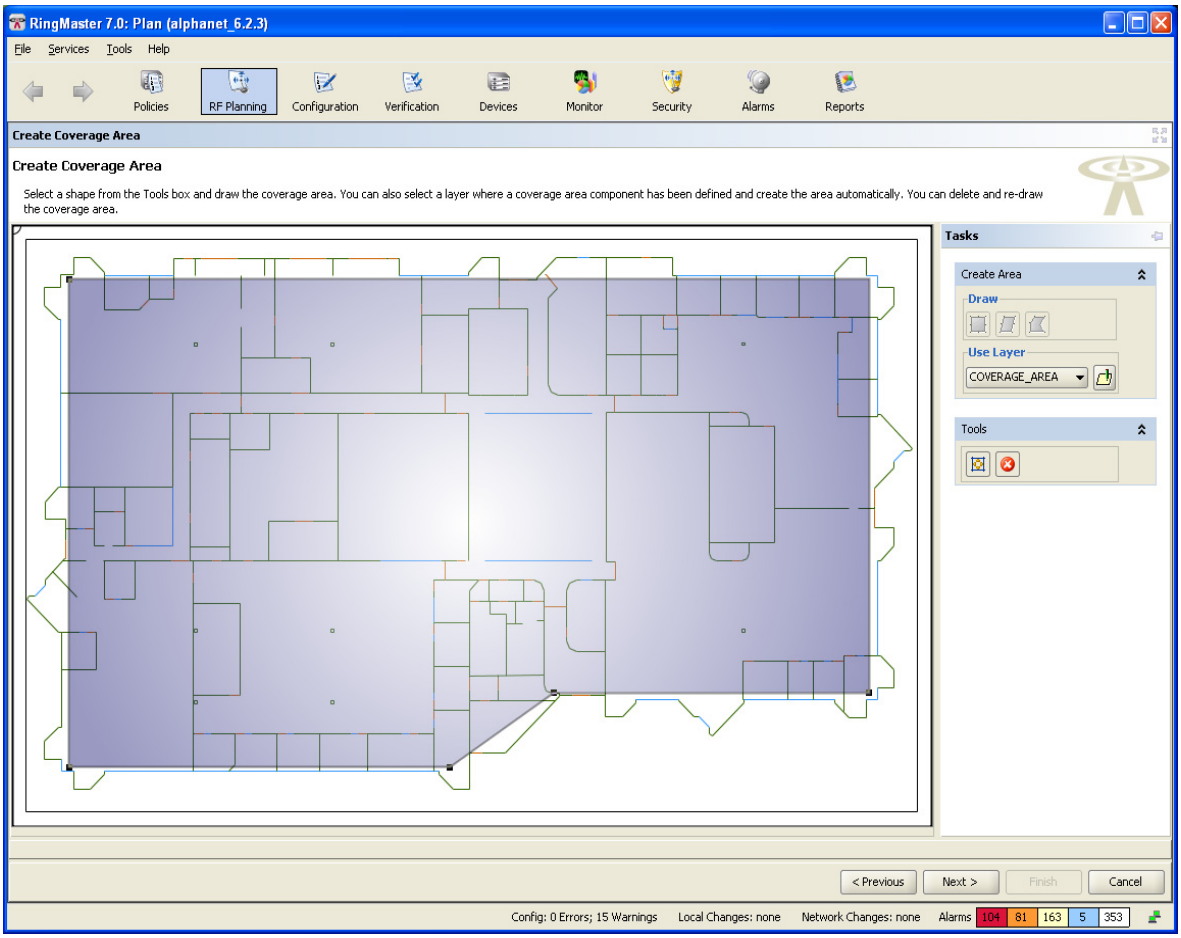
2. In the example below an area was drawn by using the mouse to draw the area shown. Click **Next**.



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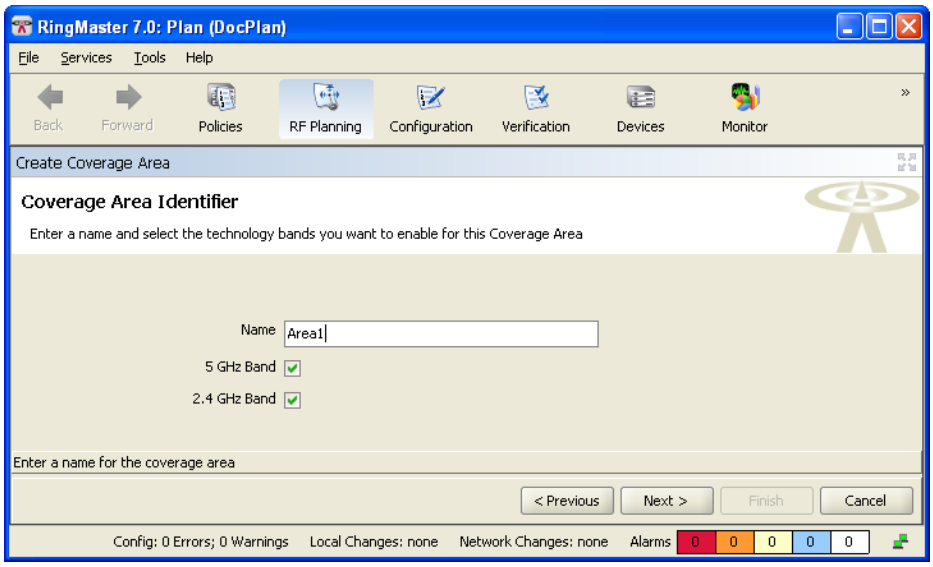
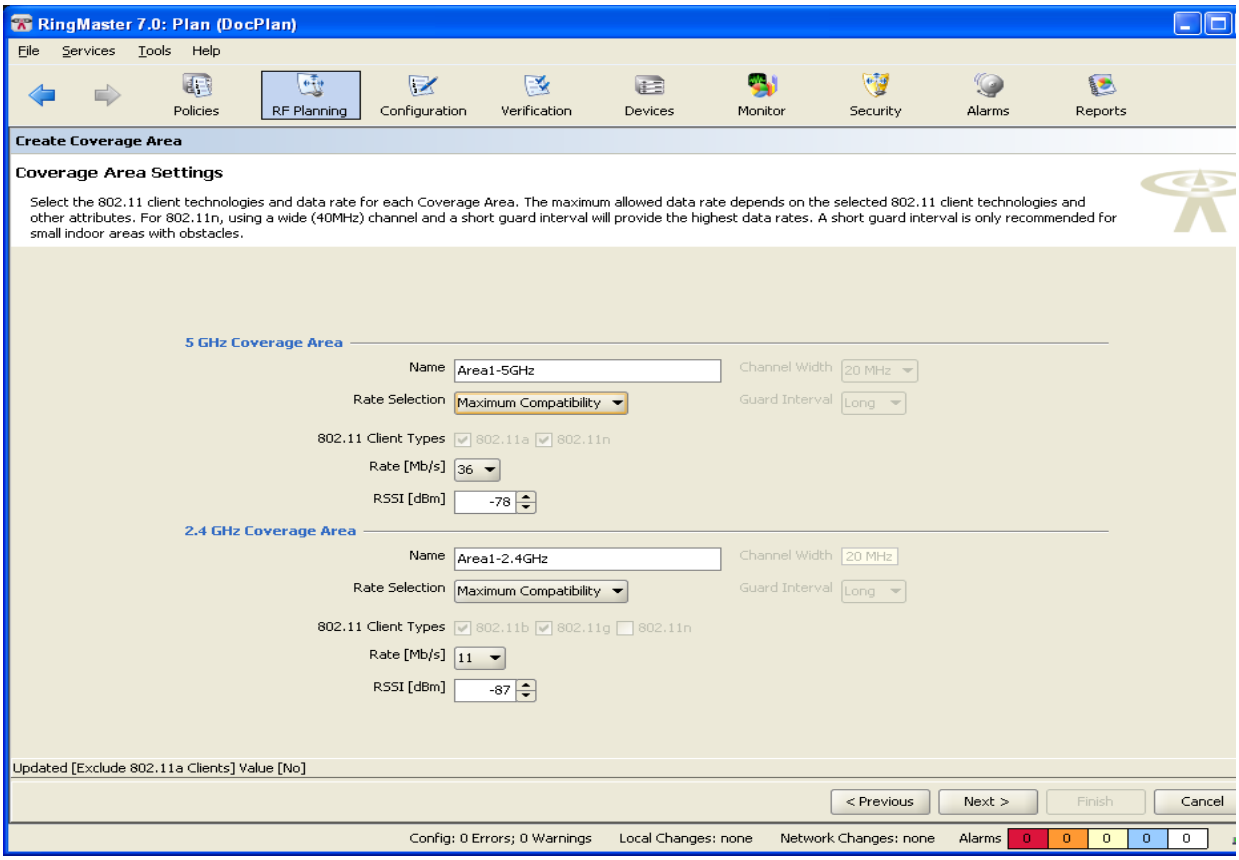
3. Select a **Coverage Area Identifier** and frequency bands to be supported, then click **Next**. Coverage areas can be planned for 802.11 wireless coverage on the 2.4Ghz, 5Ghz, or both.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor
Create Coverage Area
Coverage Area Identifier
Enter a name and select the technology bands you want to enable for this Coverage Area
Name Area1
5 GHz Band
2.4 GHz Band
Enter a name for the coverage area
< Previous Next > Finish Cancel
Config: 0 Errors; 0 Warnings Local Changes: none Network Changes: none Alarms 0 0 0 0 0

Select an area Name and check use of the 5 GHz or 2.4 GHz Band (or both) and click **Next**.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Policies RF Planning Configuration Verification Devices Monitor Security Alarms Reports
Create Coverage Area
Coverage Area Settings
Select the 802.11 client technologies and data rate for each Coverage Area. The maximum allowed data rate depends on the selected 802.11 client technologies and other attributes. For 802.11n, using a wide (40MHz) channel and a short guard interval will provide the highest data rates. A short guard interval is only recommended for small indoor areas with obstacles.
5 GHz Coverage Area
Name Area1-5GHz
Channel Width 20 MHz
Rate Selection Maximum Compatibility
Guard Interval Long
802.11 Client Types 802.11a 802.11n
Rate [Mb/s] 36
RSSI [dBm] -78
2.4 GHz Coverage Area
Name Area1-2.4GHz
Channel Width 20 MHz
Rate Selection Maximum Compatibility
Guard Interval Long
802.11 Client Types 802.11b 802.11g 802.11n
Rate [Mb/s] 11
RSSI [dBm] -87
Updated [Exclude 802.11a Clients] Value [No]
< Previous Next > Finish Cancel
Config: 0 Errors; 0 Warnings Local Changes: none Network Changes: none Alarms 0 0 0 0 0

4. The dialog above presents **Coverage Area Options** for you to make additional selections.

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- Enter a name for both 2.4 and 5 GHz areas.
- In the **Rate Selection** list for each technology, select **Maximize Compatibility** or **Maximize Throughput**.
  - If **Maximize Compatibility** is selected, 11n clients will still be able to connect at 11n data rates. Lower data rate will be used to plan, so that floor can be covered at legacy rates. This limits overall throughput, as even though 802.11n is supported, data rates are limited to legacy rates for compatibility. Also, 802.11n specific options, like using wide channels and short guard intervals, are disabled.
  - If **Maximize Throughput** is selected, only 802.11n is set as the supported technology type and all 802.11n optimizations will be leveraged to achieve the highest possible data rates.
  - If **Custom** is selected, **802.11 client Types** check boxes are available for use in both 5 and 2.4 GHz areas, and 5 GHz **Channel Width** can be set to either 20 MHz or 40 MHz.
- Select **802.11 Client Types** for both the 5 GHz and 2.4 GHz areas

  Specify whether you want to support 802.11a, 802.11b, 802.11g, and 802.11n clients. Selected types impact available data rates. For example, if 802.11a and 802.11n are both selected, the highest data rate you can use for planning is 54 Mbps. If only 802.11n is selected, the highest data rate you can use is 300 Mbps.
- In the Rate [Mb/s] pull-down menu, select a rate for each band used.

  This value specifies the desired data rate to use for RF planning. When the RF Planning wizard computes the number of APs required and chooses the best location for each AP, it aims to achieve the highest possible coverage of the area at the selected data rate. Hence, selecting a higher data rate results in more APs being placed. You can then visualize RF coverage at all data rates.
- Select a **Channel Width** for 5 GHz.

  This option allows the use of 40 Mhz (wide) channels for 802.11n. Using wide channels will enable higher data rates.
- Select **Guard Intervals** for both the 5 GHz areas

  This option allows the use of a short guard interval for 802.11n. Using a short guard interval will enable slightly higher data rates (about 10%). A short guard interval is not recommended for outdoor areas, or large open indoor areas.
- Enter desired **RSSI Values** for both the 5 GHz and 2.4 GHz areas.

  This value specifies the desired RSSI to use for RF Planning. It is directly related to the data rate, in a manner where changing one value will impact the other. If you specify an RSSI value, the lowest data rate required to achieve the RSSI will be configured.

Click **Next**.

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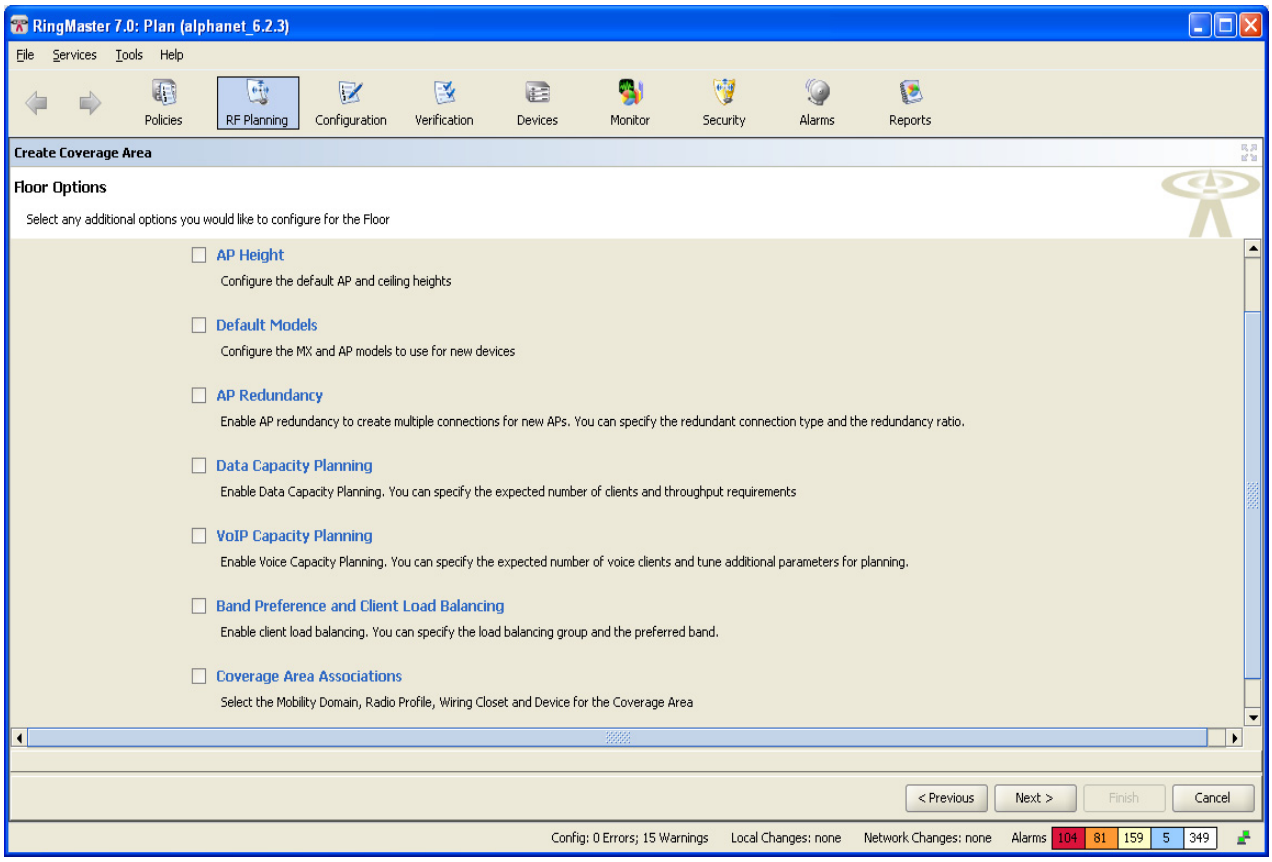
Floor Options

5. You now see the **Floor Options** dialog.


RingMaster 7.0: Plan (alphanet_6.2.3)
File
Services
Tools
Help
Policies
RF Planning
Configuration
Verification
Devices
Monitor
Security
Alarms
Reports
Create Coverage Area
Floor Options
Select any additional options you would like to configure for the Floor
AP Height
Configure the default AP and ceiling heights
Default Models
Configure the MX and AP models to use for new devices
AP Redundancy
Enable AP redundancy to create multiple connections for new APs. You can specify the redundant connection type and the redundancy ratio.
Data Capacity Planning
Enable Data Capacity Planning. You can specify the expected number of clients and throughput requirements
VoIP Capacity Planning
Enable Voice Capacity Planning. You can specify the expected number of voice clients and tune additional parameters for planning.
Band Preference and Client Load Balancing
Enable client load balancing. You can specify the load balancing group and the preferred band.
Coverage Area Associations
Select the Mobility Domain, Radio Profile, Wiring Closet and Device for the Coverage Area
< Previous
Next >
Finish
Cancel
Config: 0 Errors; 15 Warnings
Local Changes: none
Network Changes: none
Alarms
104
81
159
5
349

You select functions you want to perform and click **Next**.

The paragraphs below assume **all** were checked and then **Next** was selected.

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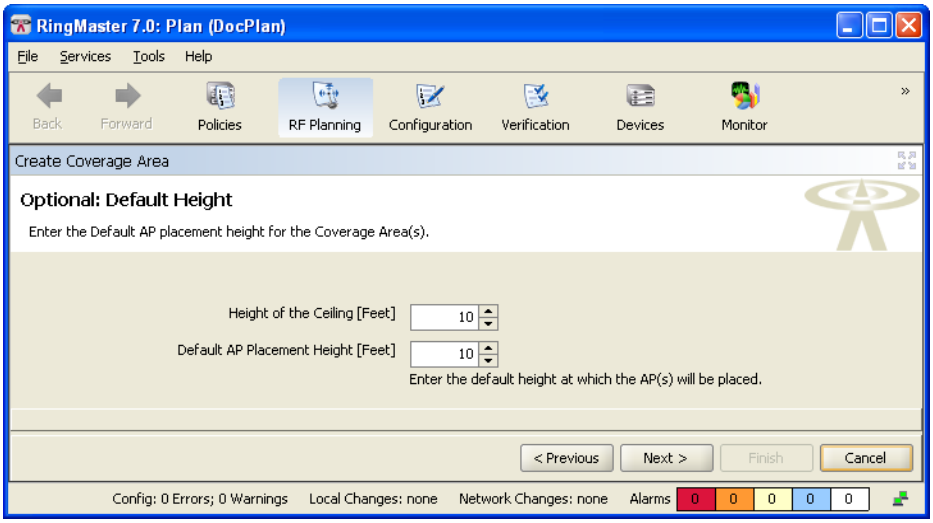
AP Height

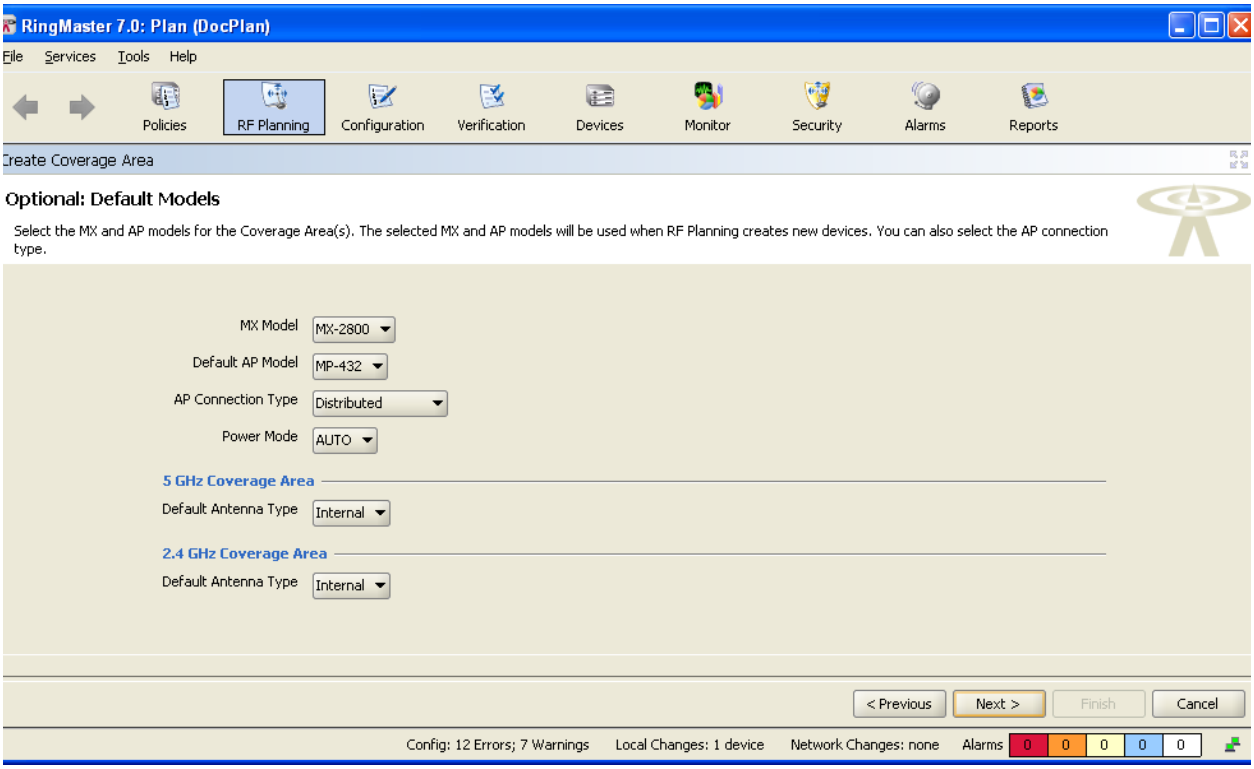
6. Selecting **AP Height** displays the following:


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor
Create Coverage Area
Optional: Default Height
Enter the Default AP placement height for the Coverage Area(s).
Height of the Ceiling [Feet]
10
Default AP Placement Height [Feet]
10
Enter the default height at which the AP(s) will be placed.
< Previous
Next >
Finish
Cancel
Config: 0 Errors; 0 Warnings
Local Changes: none
Network Changes: none
Alarms
0 0 0 0 0

Select the ceiling height and default MP (AP) placement height. Click **Next**.

Default Models

7. **Optional: Default Models** dialog appears:


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Policies RF Planning Configuration Verification Devices Monitor Security Alarms Reports
Create Coverage Area
Optional: Default Models
Select the MX and AP models for the Coverage Area(s). The selected MX and AP models will be used when RF Planning creates new devices. You can also select the AP connection type.
MX Model
MX-2800
Default AP Model
MP-432
AP Connection Type
Distributed
Power Mode
AUTO
5 GHz Coverage Area
Default Antenna Type
Internal
2.4 GHz Coverage Area
Default Antenna Type
Internal
< Previous
Next >
Finish
Cancel
Config: 12 Errors; 7 Warnings
Local Changes: 1 device
Network Changes: none
Alarms
0 0 0 0 0

8. To change the default MX model, select a model from the **MX Model** pull-down menu.

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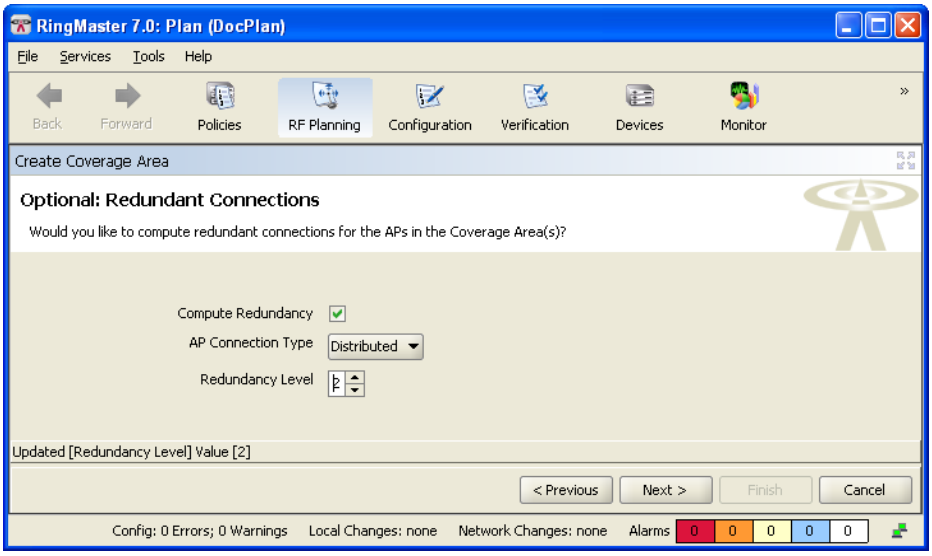
9. To change the default AP model, select a model from the **Default AP Model** pull-down menu.
10. To change the **AP Connection Type**, select one of the following types from the **AP Connection Type** pull-down menu:
    - **Direct** — APs directly attached to dedicated MX ports.
    - **Distributed** — APs indirectly attached through intermediate Layer 2 or Layer 3 devices.
    - **Distributed (Auto)** — APs indirectly attached through intermediate Layer 2 or Layer 3 devices that receive their configuration automatically using a profile that assigns a Distributed AP number and name to the AP from among unused valid AP numbers available on the MX.
    - **Power Mode** — Select **AUTO** or **HIGH**. Valid choices are **Auto** and **High Power**. For **Auto**, the AP will detect the power automatically and depending on the power it will use 2 x 3 or 3 x 3 antennas. For High power it will always use 3 x 3.

    Click **Next**.

Redundant Connections

11. The **Optional: Redundant Connections** dialog is displayed. Select whether the system should **Compute Redundancy**, specify an **AP Connection Type**, and use the scrolling list to select a **Redundancy Level**, then click **Next**.



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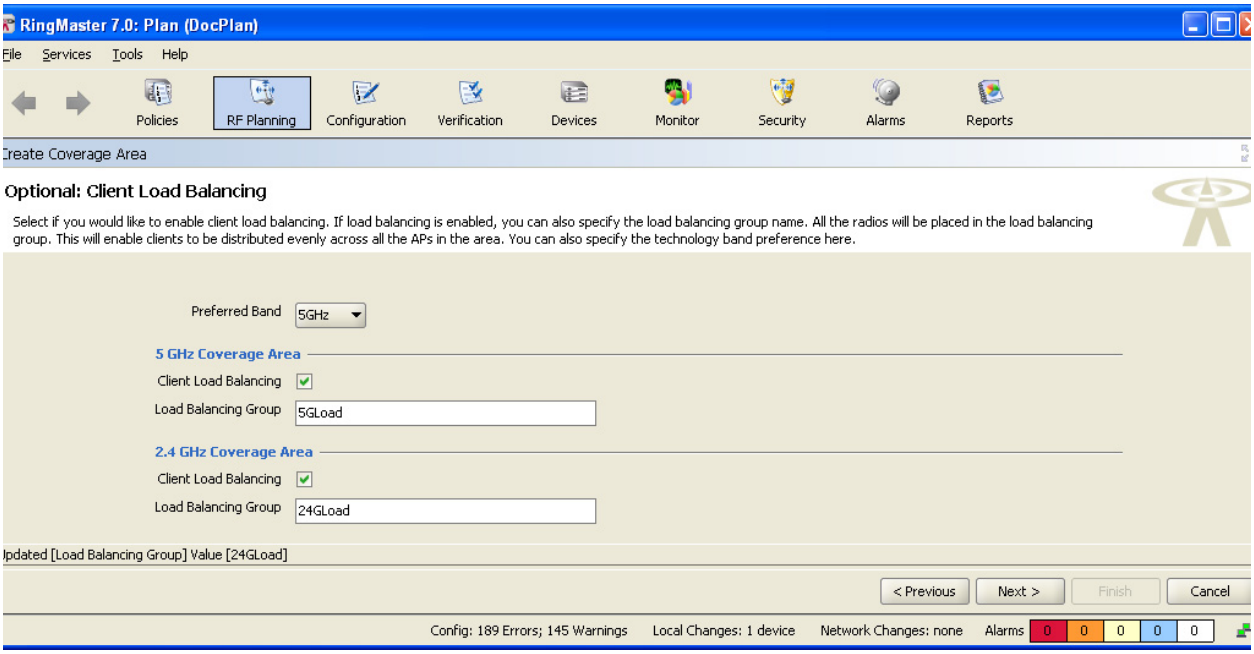
Client Load Balancing

12. The **Optional: Client Load Balancing** dialog allows you to specify **Client Load Balancing** for either 5 GHz, 2.4 GHz band or both, and enter a **Load Balancing Group** name for any bands selected.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Policies
RF Planning
Configuration
Verification
Devices
Monitor
Security
Alarms
Reports
Create Coverage Area
Optional: Client Load Balancing
Select if you would like to enable client load balancing. If load balancing is enabled, you can also specify the load balancing group name. All the radios will be placed in the load balancing group. This will enable clients to be distributed evenly across all the APs in the area. You can also specify the technology band preference here.
Preferred Band
5GHz
5 GHz Coverage Area
Client Load Balancing
Load Balancing Group
5GLoad
2.4 GHz Coverage Area
Client Load Balancing
Load Balancing Group
24GLoad
Updated [Load Balancing Group] Value [24GLoad]
< Previous
Next >
Finish
Cancel
Config: 189 Errors; 145 Warnings
Local Changes: 1 device
Network Changes: none
Alarms
0 0 0 0 0

Capacity Planning for Data

13. The **Optional: Capacity Planning for Data** dialog appears. Specify whether to **Use Capacity Calculation for Data** at 5 GHz or 2.4 GHz or both. By default, *RingMaster* performs only

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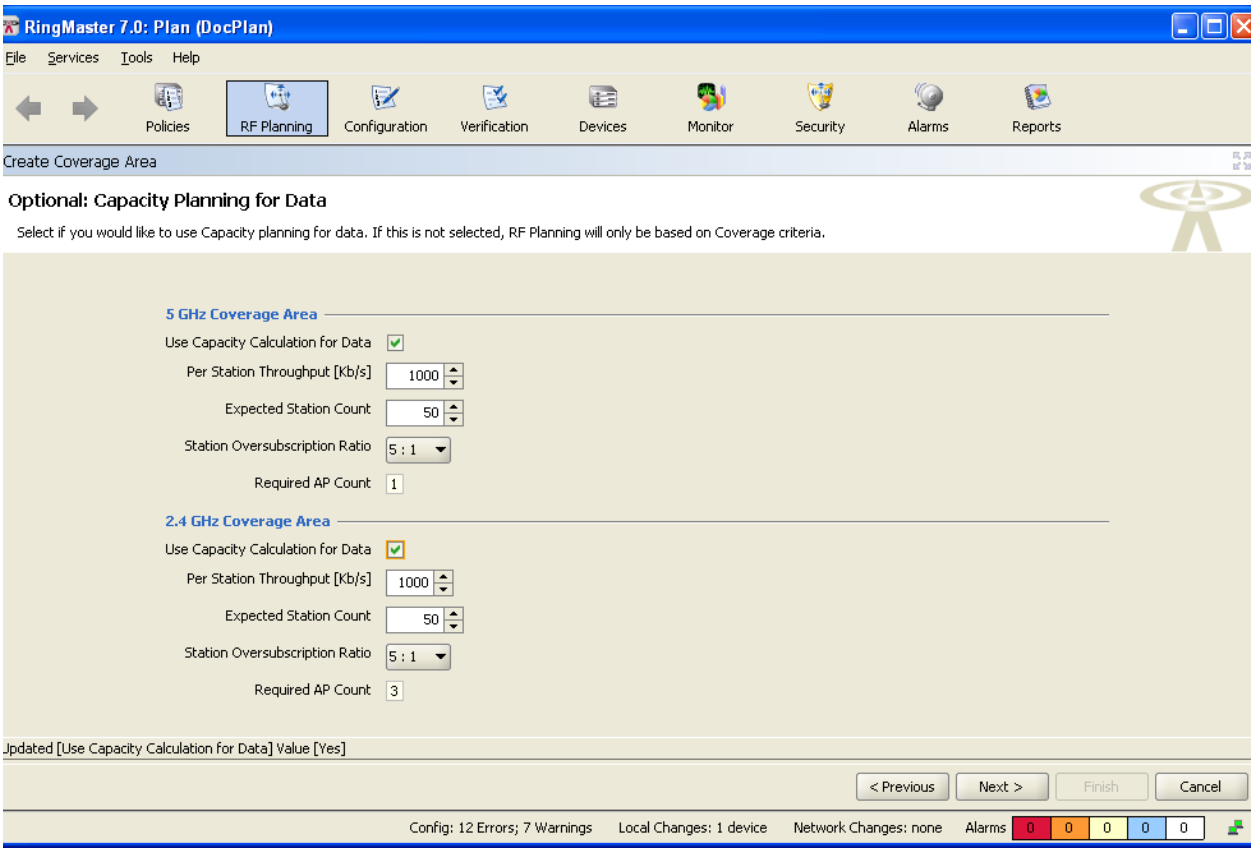
coverage calculations. If you enable the **Use Capacity Calculation for Data** option, *RingMaster* performs data calculations.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Policies
RF Planning
Configuration
Verification
Devices
Monitor
Security
Alarms
Reports
Create Coverage Area
Optional: Capacity Planning for Data
Select if you would like to use Capacity planning for data. If this is not selected, RF Planning will only be based on Coverage criteria.
5 GHz Coverage Area
Use Capacity Calculation for Data
Per Station Throughput [Kb/s] 1000
Expected Station Count 50
Station Oversubscription Ratio 5 : 1
Required AP Count 1
2.4 GHz Coverage Area
Use Capacity Calculation for Data
Per Station Throughput [Kb/s] 1000
Expected Station Count 50
Station Oversubscription Ratio 5 : 1
Required AP Count 3
Updated [Use Capacity Calculation for Data] Value [Yes]
< Previous
Next >
Finish
Cancel
Config: 12 Errors; 7 Warnings
Local Changes: 1 device
Network Changes: none
Alarms 0 0 0 0 0

- From the **Per Station Throughput** list, specify the throughput (combined transmit and receive) in kilobits per second (Kbps) for a station.
- From the **Expected Station Count** list, specify the number of clients you expect to be in the coverage area.
- In the **Station Oversubscription Ratio** list, select the ratio for the average transmit behavior of the stations. The station oversubscription ratio is the ratio of active clients compared to total clients. For example, the ratio 5:1 indicates that, statistically, 20 percent of the clients are active at any given time.
- A **Required AP Count** is shown. This is the number of APs that required to meet capacity constraints.

Click **Next**.

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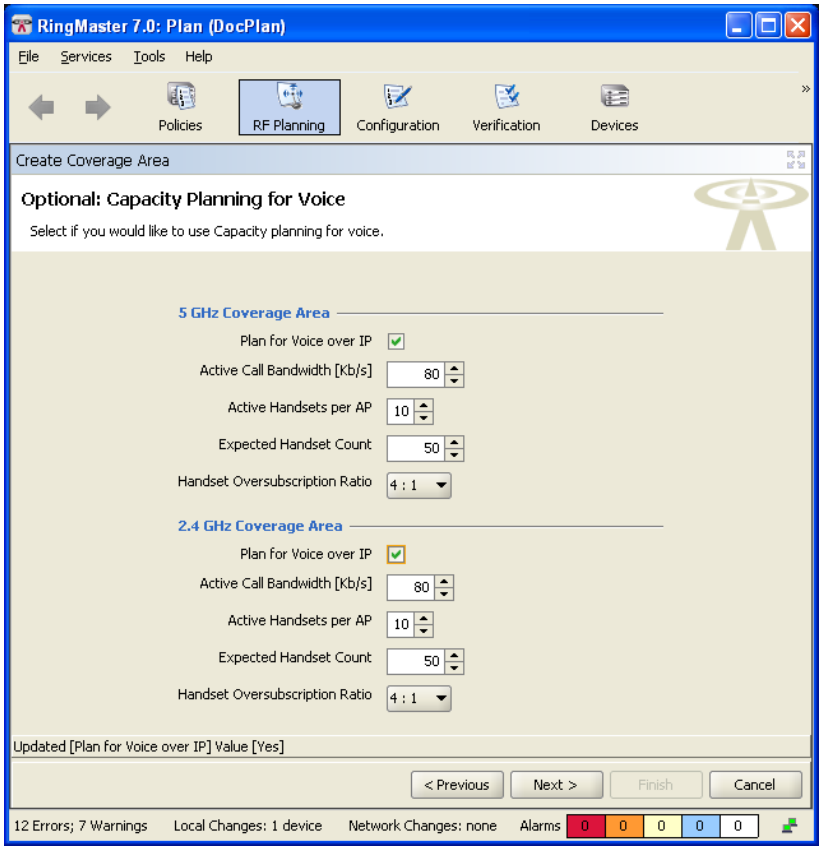
Capacity Planning for Voice

14. The **Optional: Capacity Planning for Voice** dialog appears.



To calculate AP placement and configuration based on both coverage and on capacity for voice over IP, enable **Plan for Voice over IP**. By default, *RingMaster* performs only coverage calculations. If you enable the **Plan for Voice over IP** option, *RingMaster* calculates both.

- From the **Active Call Bandwidth** list, specify the amount of bandwidth in kilobits per second (Kbps) that you expect for each call.
- From the **Active Handsets per AP** list, specify the number of voice over IP phones for each AP.
- From the **Expected Handset Count** list, specify the number of voice over IP phones you expect to be in the coverage area.
- From the **Handset Oversubscription Ratio** list, select the ratio for the average transmit behavior of the voice over IP phones. The handset oversubscription ratio is the ratio of active handsets compared to total handsets. For example, the ratio 4:1 indicates that, statistically, 25 percent of the voice over IP phones are active at any given time.

Click **Next**.

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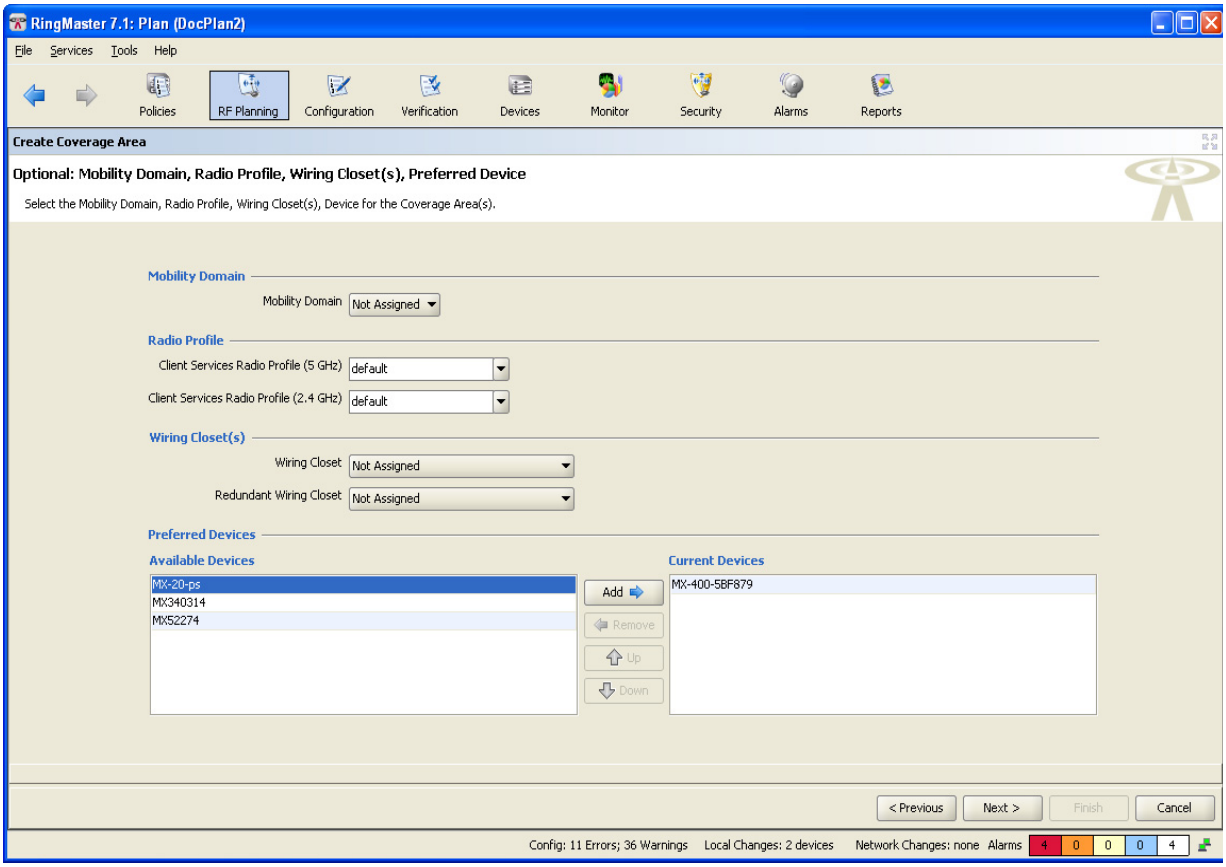
Mobility Domain, Radio Profile, Wiring Closet(s), Preferred Device

15. The **Optional: Mobility Domain, Radio Profile, Wiring closet(s), Preferred Device** dialog appears.



From the **Mobility Domain** pull-down menu, select a Mobility Domain containing the APs in this coverage area.

- In the **Radio Profile** pull-down menu, select the radio profile used for 5 GHz and 2.4 GHz coverage areas. Profiles available depend on the Mobility Domain selected. The selected profile applies to all radios associated with a coverage area. If you type the name of a radio profile that does not exist, *RingMaster* creates one with this name.
- In the **Wiring Closet** pull-down menu, select the wiring closet with the MXs to be connected to shared APs. If APs are directly connected to MXs, a wiring closet is required. If all APs in a coverage area are indirectly connected to MXs through a network, a wiring closet is not required.
- In the **Redundant Wiring Closet** pull-down menu, select a wiring closet providing redundant connection to APs. This is required for directly connected APs if you want APs to have redundant connections. Otherwise, this is not required.
- In **Preferred Devices**, select and move appropriate **Available Devices** to the **Current Devices** list.

Click **Next**.

Refer to the descriptions of **Mobility Domains** in the publication *RingMaster 7.4 Configuration Guide*.

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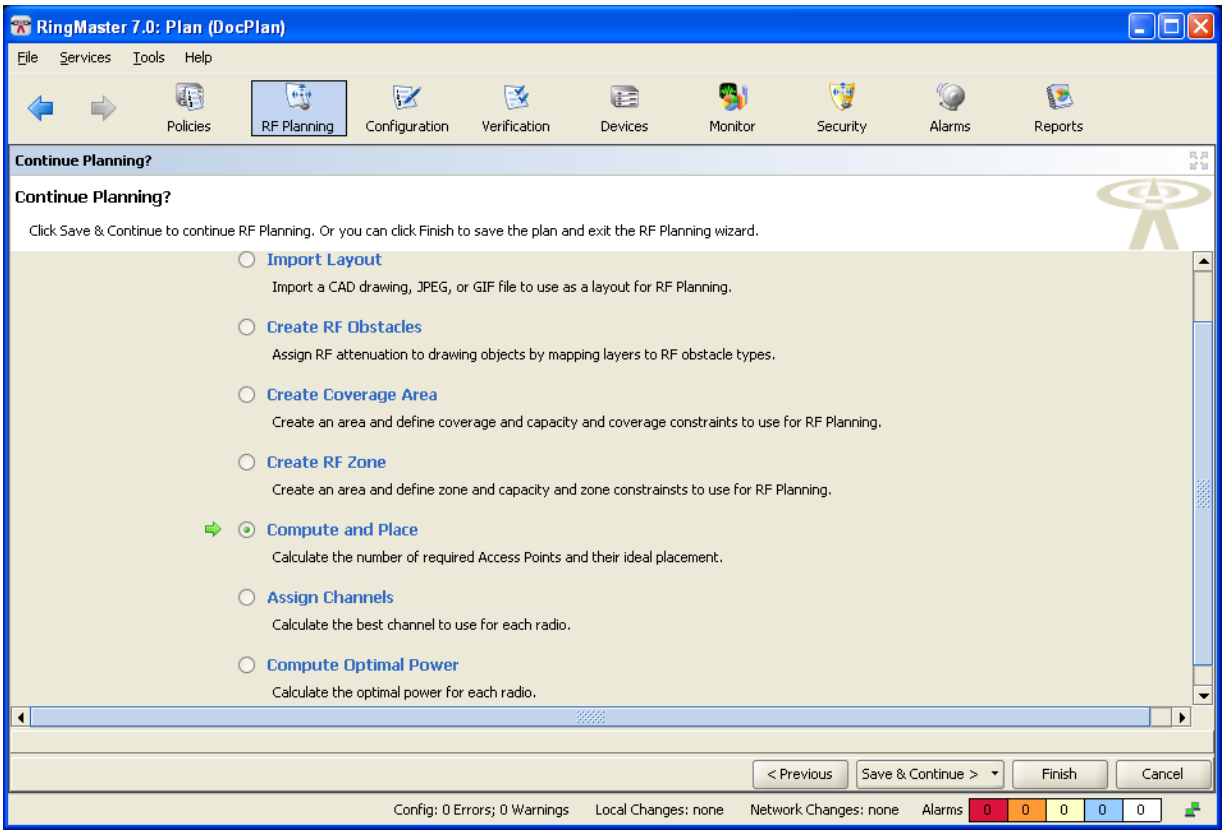
16. The **Continue Planning?** dialog appears with **Compute and Place** highlighted. Click **Save and continue**.


RingMaster 7.0: Plan (DocPlan)
File
Services
Tools
Help
Policies
RF Planning
Configuration
Verification
Devices
Monitor
Security
Alarms
Reports
Continue Planning?
Continue Planning?
Click Save & Continue to continue RF Planning. Or you can click Finish to save the plan and exit the RF Planning wizard.
Import Layout
Import a CAD drawing, JPEG, or GIF file to use as a layout for RF Planning.
Create RF Obstacles
Assign RF attenuation to drawing objects by mapping layers to RF obstacle types.
Create Coverage Area
Create an area and define coverage and capacity and coverage constraints to use for RF Planning.
Create RF Zone
Create an area and define zone and capacity and zone constrainsts to use for RF Planning.
Compute and Place
Calculate the number of required Access Points and their ideal placement.
Assign Channels
Calculate the best channel to use for each radio.
Compute Optimal Power
Calculate the optimal power for each radio.
< Previous
Save & Continue >
Finish
Cancel
Config: 0 Errors; 0 Warnings
Local Changes: none
Network Changes: none
Alarms
0
0
0
0
0

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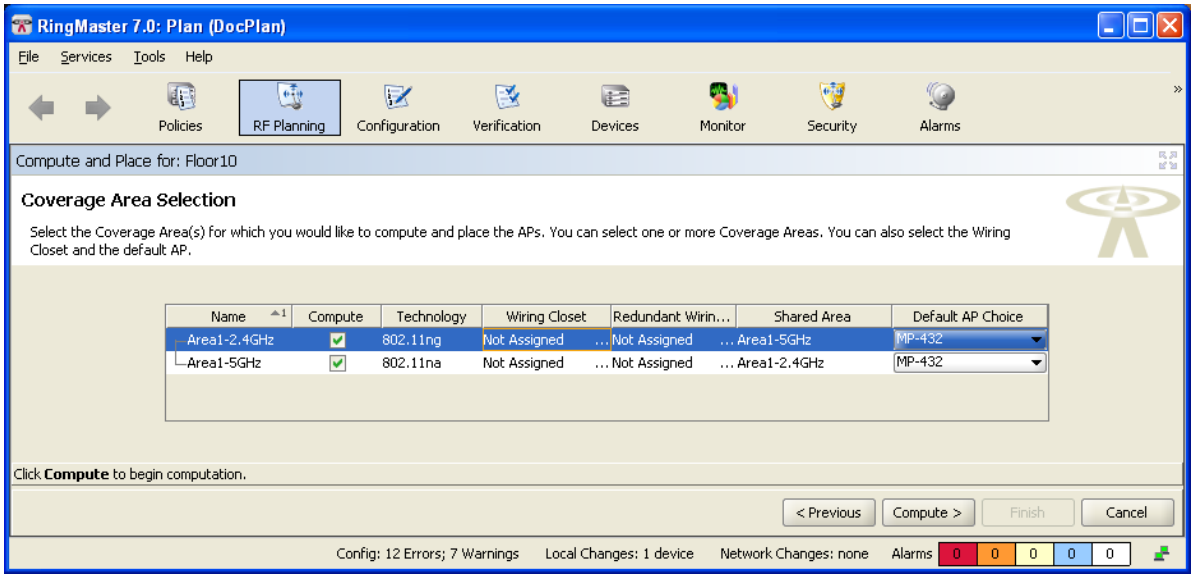
Compute and Place

17. The **Compute and Place** dialog allows you to select areas in which to compute and place APs. Select items in the **Compute Layout** column and click **Compute**.



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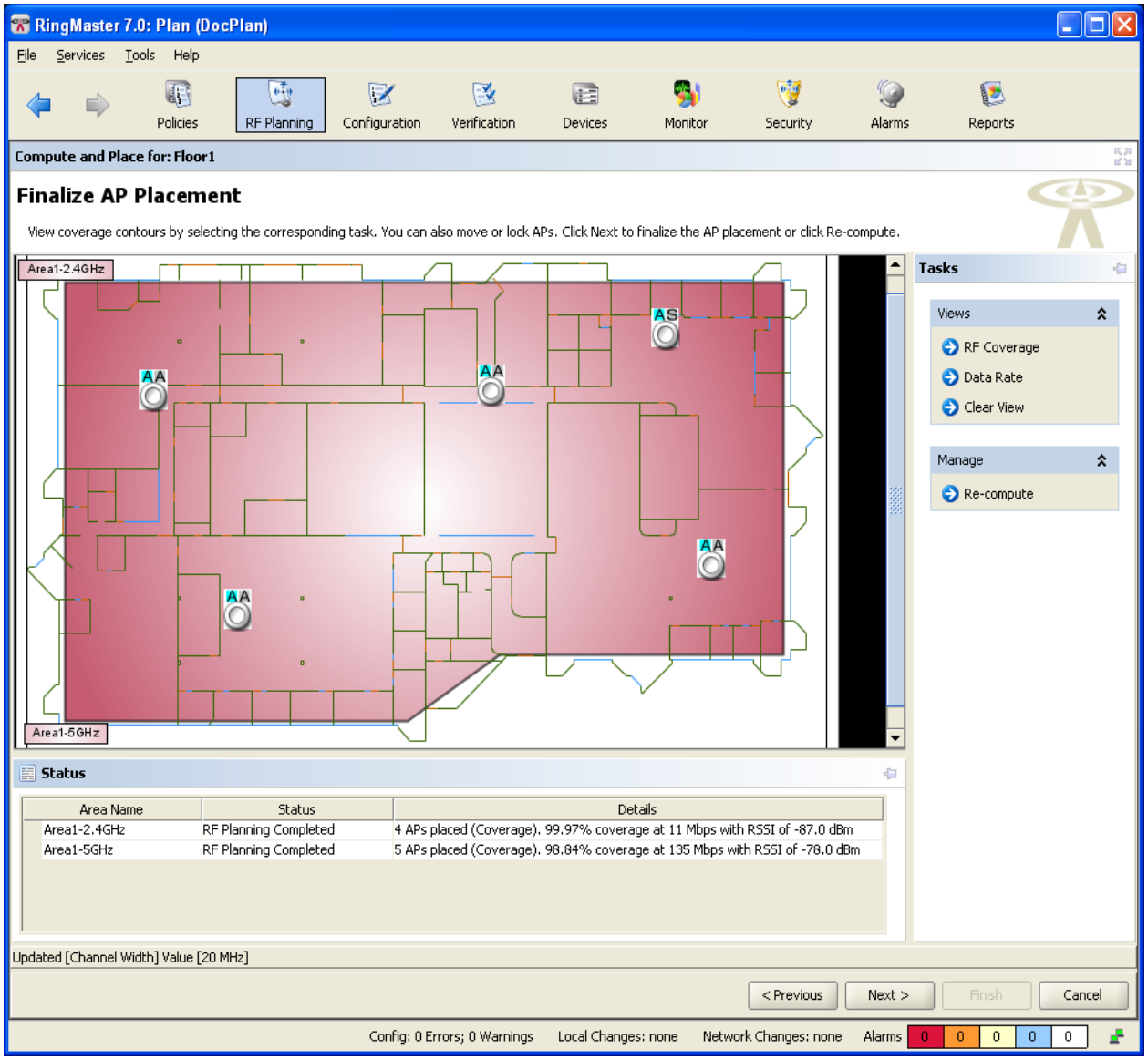
18. After a the server does computations, initial AP placement is displayed. Click **Next**.



19. You now see the **Continue Planning?** dialog with **Assign Channels** selected. Click **Save and Continue** to proceed or **Finish** to exit the wizard,

At any **Continue Planning?** dialog, you can select an item *other than* the one with the arrow, but this removes this process from the wizard and, depending on the status of other settings, may result in errors.

Select **Save and Continue**.

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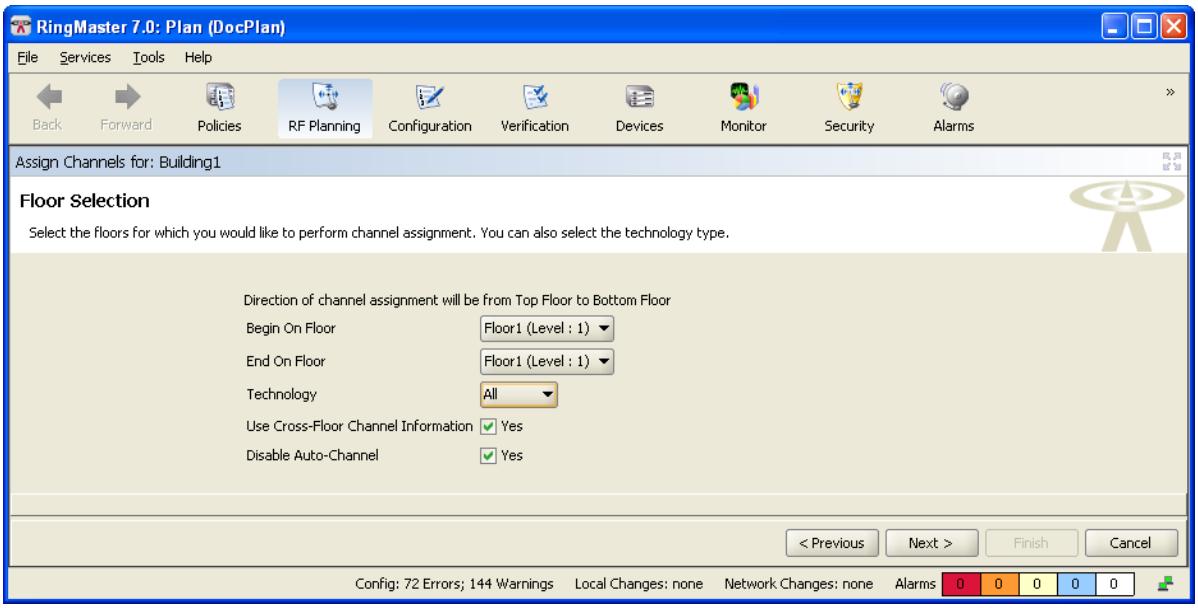
20. The **Floor Selection** dialog is displayed:


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security Alarms
Assign Channels for: Building1
Floor Selection
Select the floors for which you would like to perform channel assignment. You can also select the technology type.
Direction of channel assignment will be from Top Floor to Bottom Floor
Begin On Floor
Floor1 (Level : 1)
End On Floor
Floor1 (Level : 1)
Technology
All
Use Cross-Floor Channel Information
Yes
Disable Auto-Channel
Yes
< Previous
Next >
Finish
Cancel
Config: 72 Errors; 144 Warnings
Local Changes: none
Network Changes: none
Alarms
0 0 0 0 0

Selections are:

- **Begin On Floor** — Floor at which to begin channel assignment
- **End On Floor** — Floor at which to end channel assignment
- **Technology** — Technologie(s) for which channels are to be assigned
- **Use Cross-Floor Channel Information** — Enable/disable use of cross-floor channel information
- **Disable Auto-Channel** — Enable/disable use of auto-channel feature

Click **Next**.

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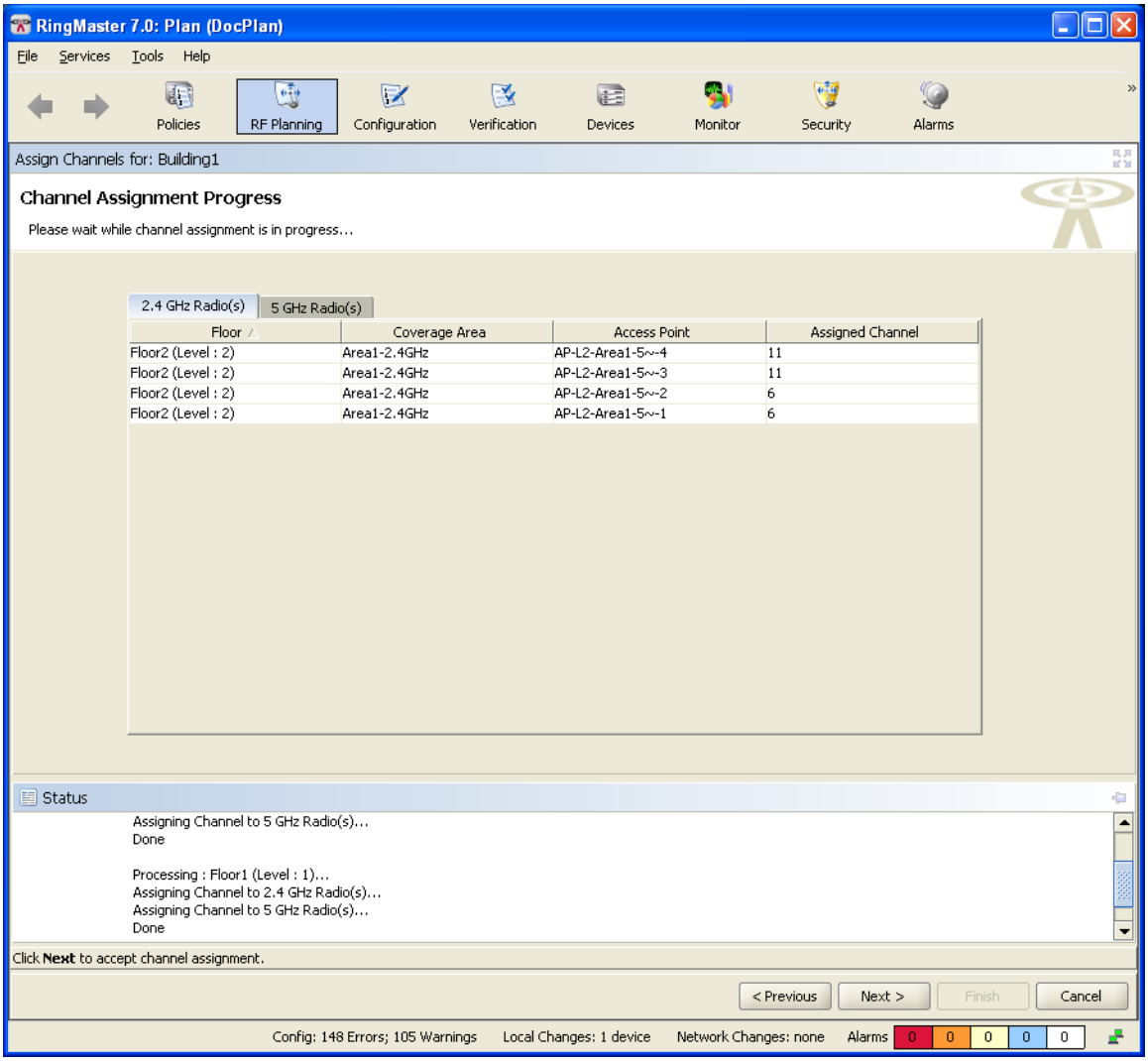
21. Channel assignment progress is displayed and a delay occurs while this process completes and then displays **Done** in the **Status** area. Click **Next**.



You now see the **Continue Planning?** dialog with **Compute Optimal Power** selected. Click **Save and Continue** to proceed or **Finish** to exit the wizard

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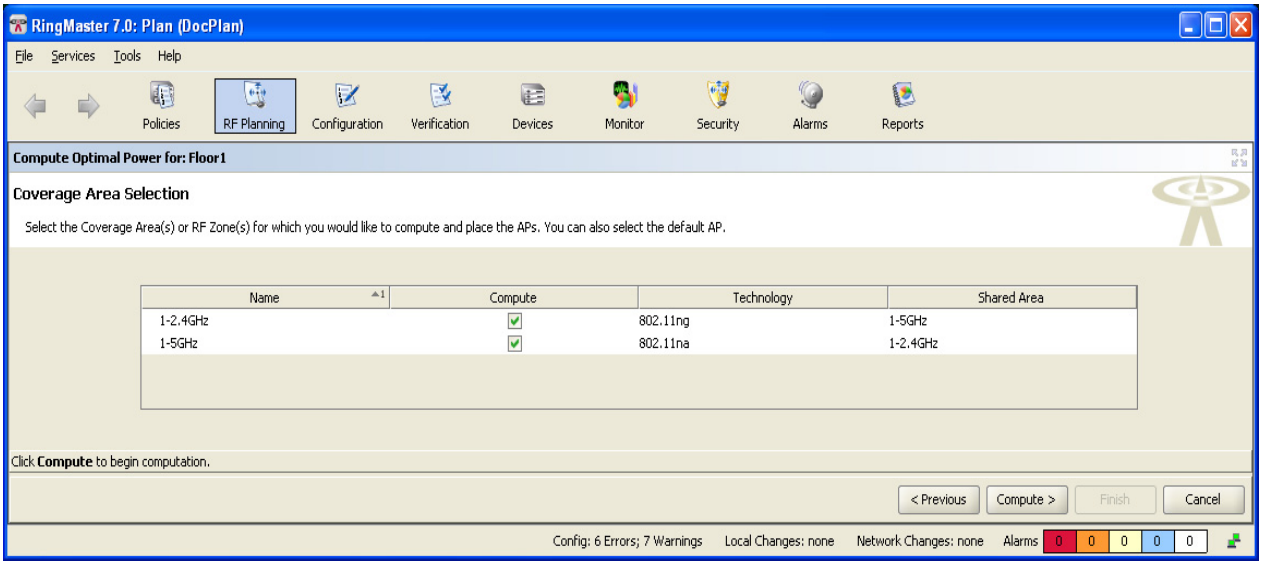
Compute Optimal Power

22. The **Coverage Area Selection** dialog is displayed. Select **Compute** box(es) for 2.4 and 5 GHz frequencies and **Optimize AP Count** if desired. Click **Compute** to proceed.



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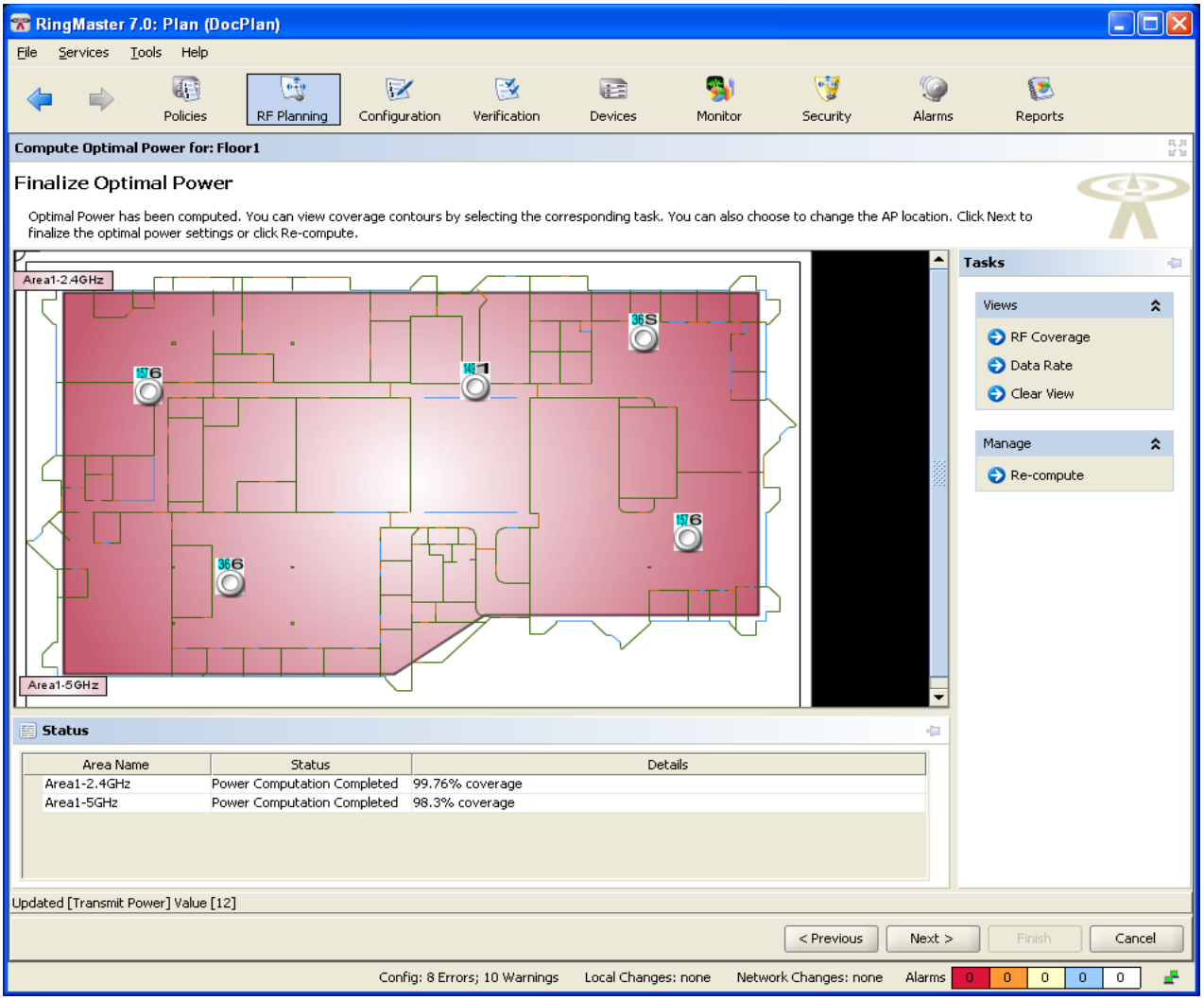
23. You next see a **Finalize Optimal Power** window. Click **Next**.



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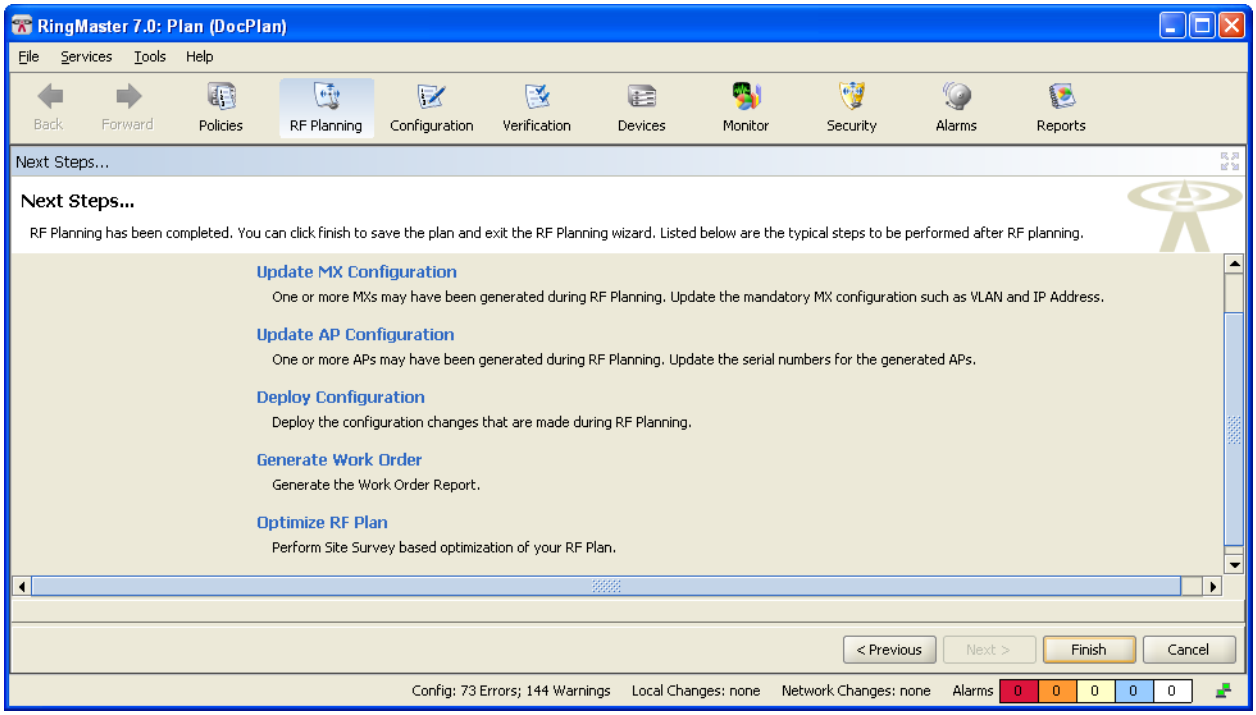
24. This wizard is now complete. You are presented with a dialog listing **Next Steps...** indicating typical steps you should perform after using the RF Planing Wizard.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security Alarms Reports
Next Steps...
Next Steps...
RF Planning has been completed. You can click finish to save the plan and exit the RF Planning wizard. Listed below are the typical steps to be performed after RF planning.
Update MX Configuration
One or more MXs may have been generated during RF Planning. Update the mandatory MX configuration such as VLAN and IP Address.
Update AP Configuration
One or more APs may have been generated during RF Planning. Update the serial numbers for the generated APs.
Deploy Configuration
Deploy the configuration changes that are made during RF Planning.
Generate Work Order
Generate the Work Order Report.
Optimize RF Plan
Perform Site Survey based optimization of your RF Plan.
< Previous
Next >
Finish
Cancel
Config: 73 Errors; 144 Warnings
Local Changes: none
Network Changes: none
Alarms 0 0 0 0 0

Read and note these suggestions and click **Finish.**

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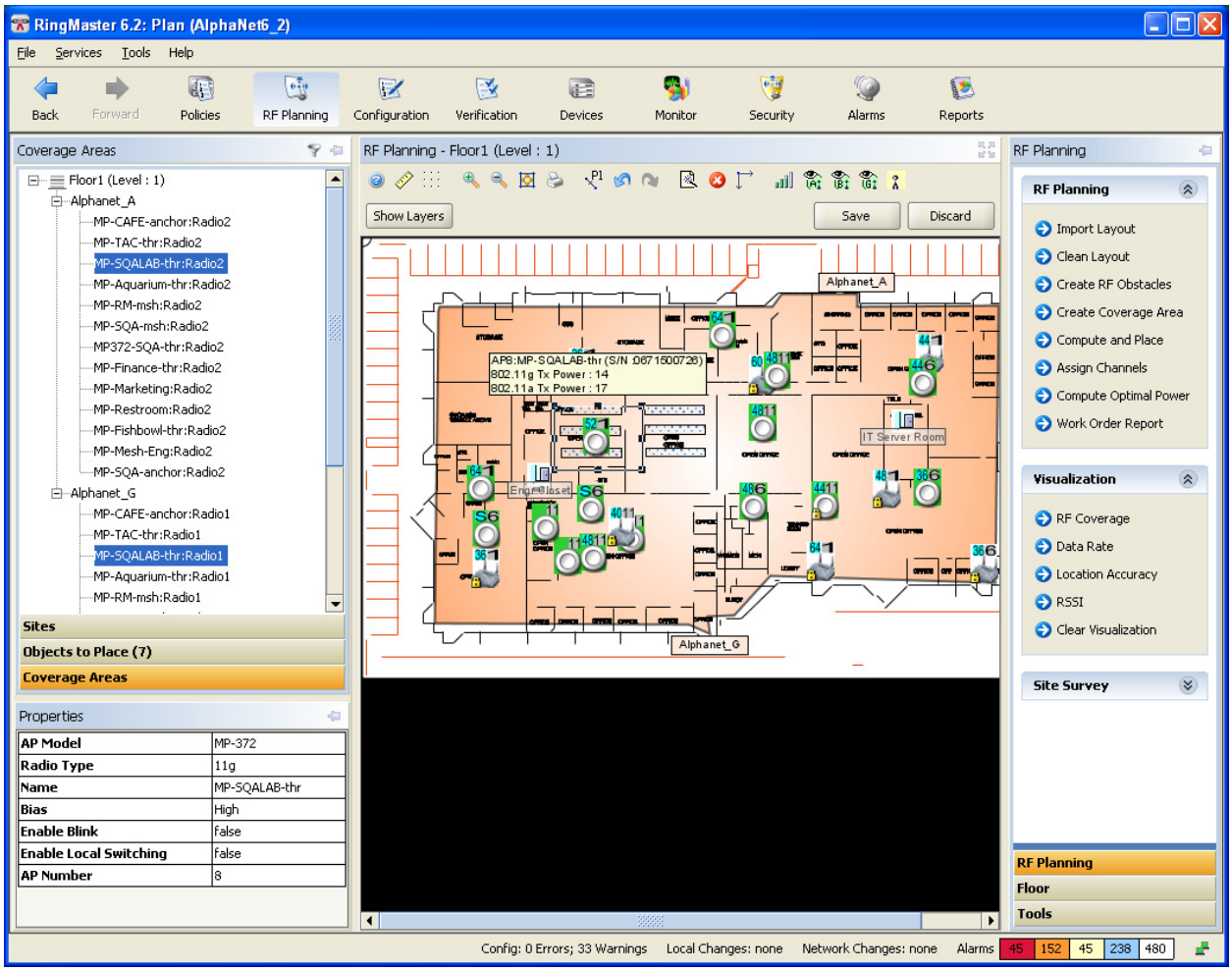
Accessing Information from Floor View

During the RF Planning process, APs are placed on floor plan drawings, and floor plan views provide an excellent means for accessing information about individual APs. The example below demonstrates some of these features:



Clicking on an AP provides information near its icon as well as in the **Properties** area in the bottom left of the window. There are also labels on the 11A and 11G coverage areas that allow you to view properties of each AP or coverage area individually.

For more detail on **Content** panel Floor Plan View icons, refer to **"Content Panel Icons"** in the *RingMaster 7.4 Configuration Guide*.

Information displays and menus available with a right-click when an AP is selected and highlighted are shown in the example below:

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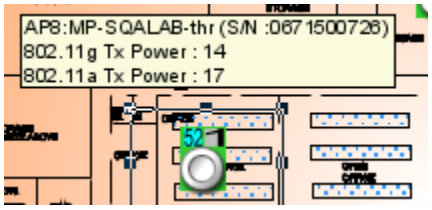
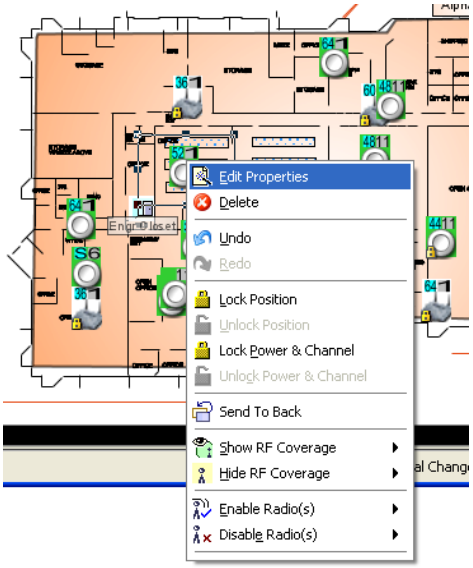
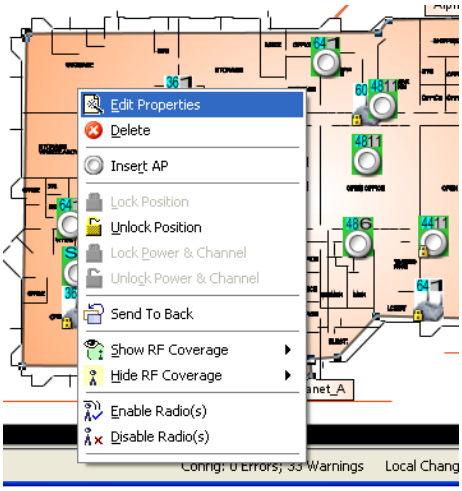
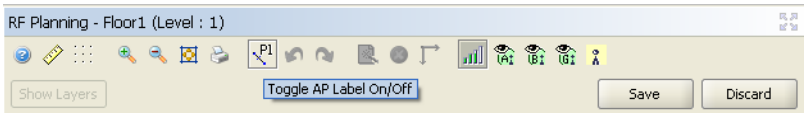




You can also click on a coverage area to see a pull-down as well. The icons above a floor view will indicate their functions when you pause your cursor over them as shown in the example (**Toggle AP Label On/Off**) at the right below.





There are a number of **RF Planning** tools available in the **Tasks** panel shown by clicking on the **Enable/Disable RF Measurements mode** icon as shown below:

This changes the **Tasks** panel to add **Measurement Mode** items shown below. The illustration below shows the **Measurement Mode** items **RF Point**, **RSSI Options**, **802.11a** and **802.11b/g** areas without

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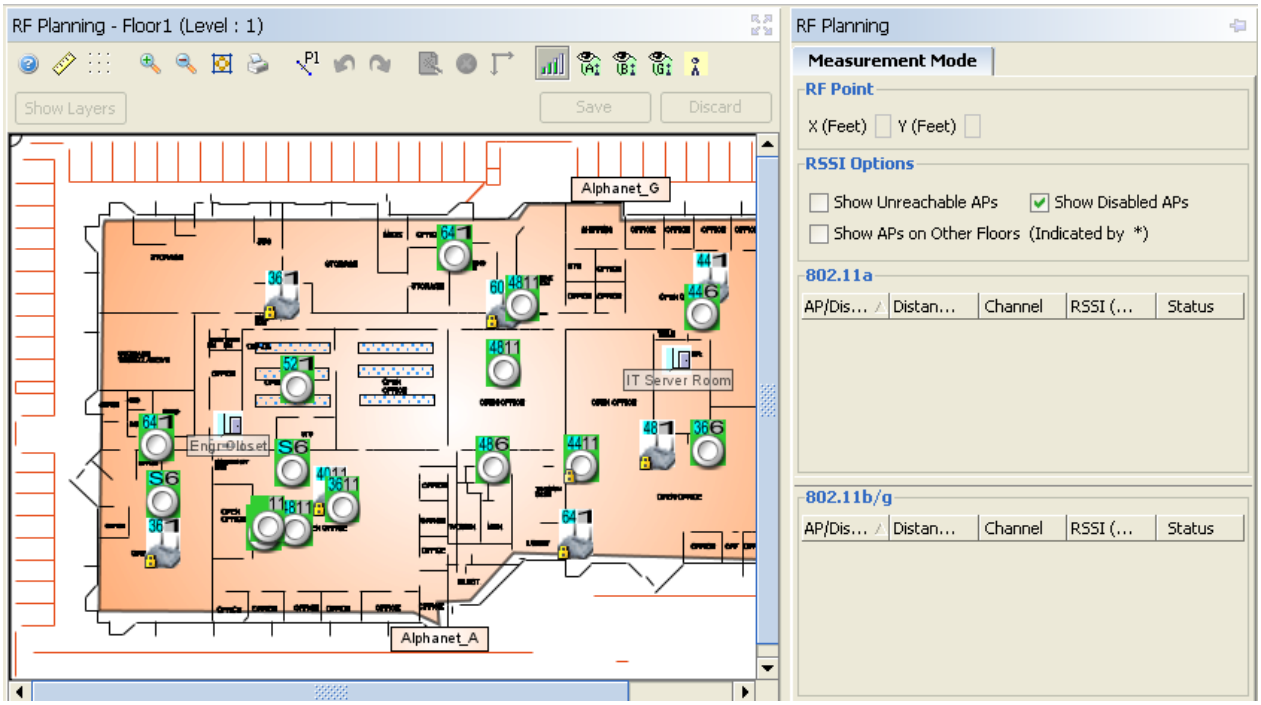
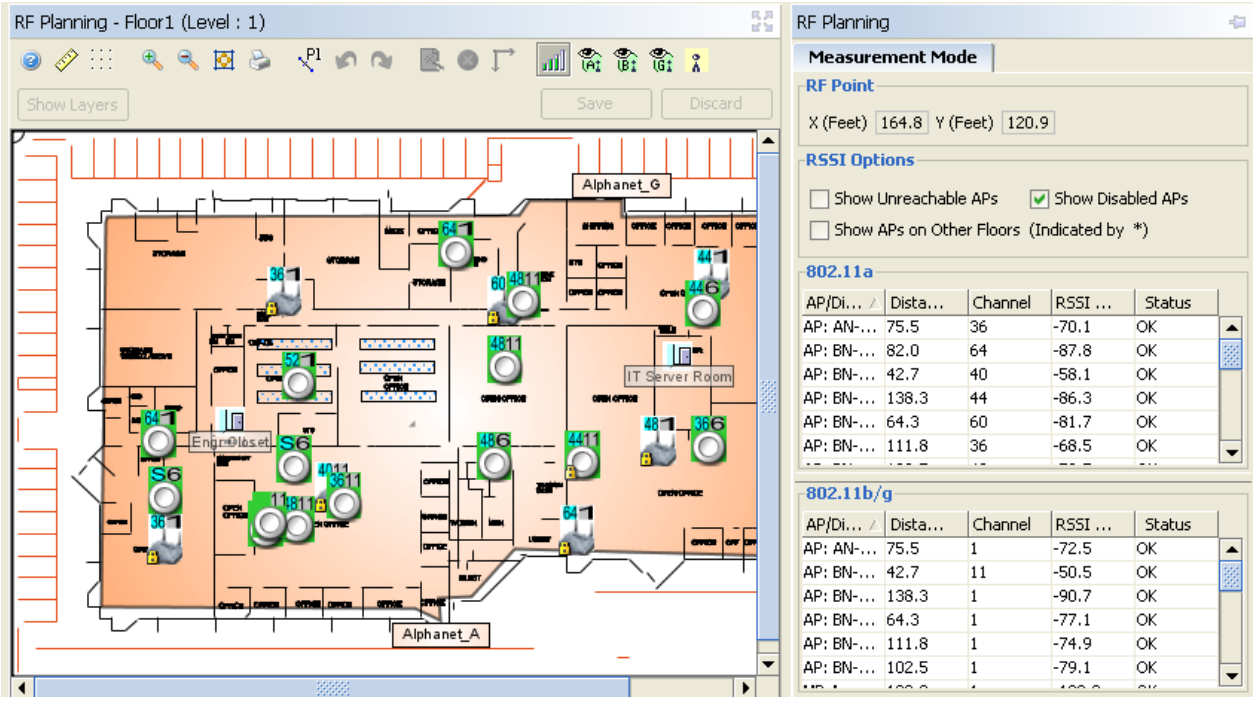
information in them. If you then click with your cursor on a point on the floor plan, you see the second illustration with information relevant to the point where you clicked.





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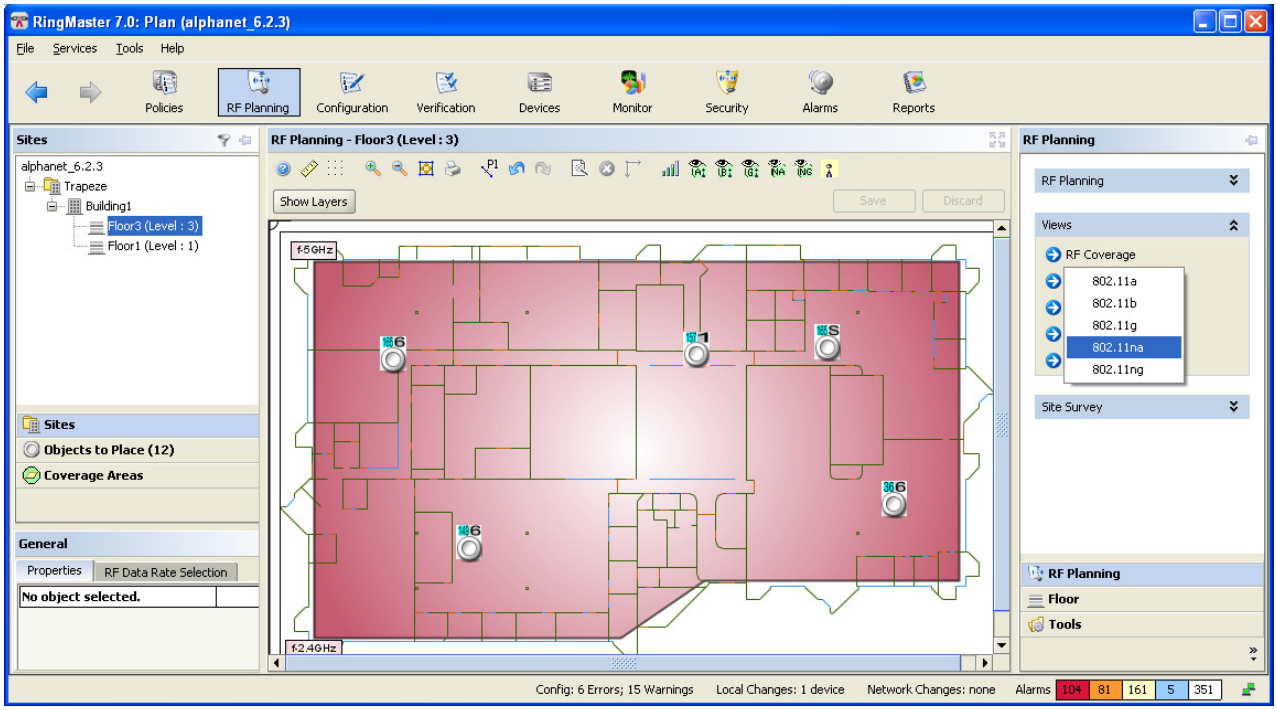
Visualizing RF Coverage

After you have done this much RF Planning, you can visualize RF Coverage at various data rates using the **Tasks** panel item **RF Coverage**.



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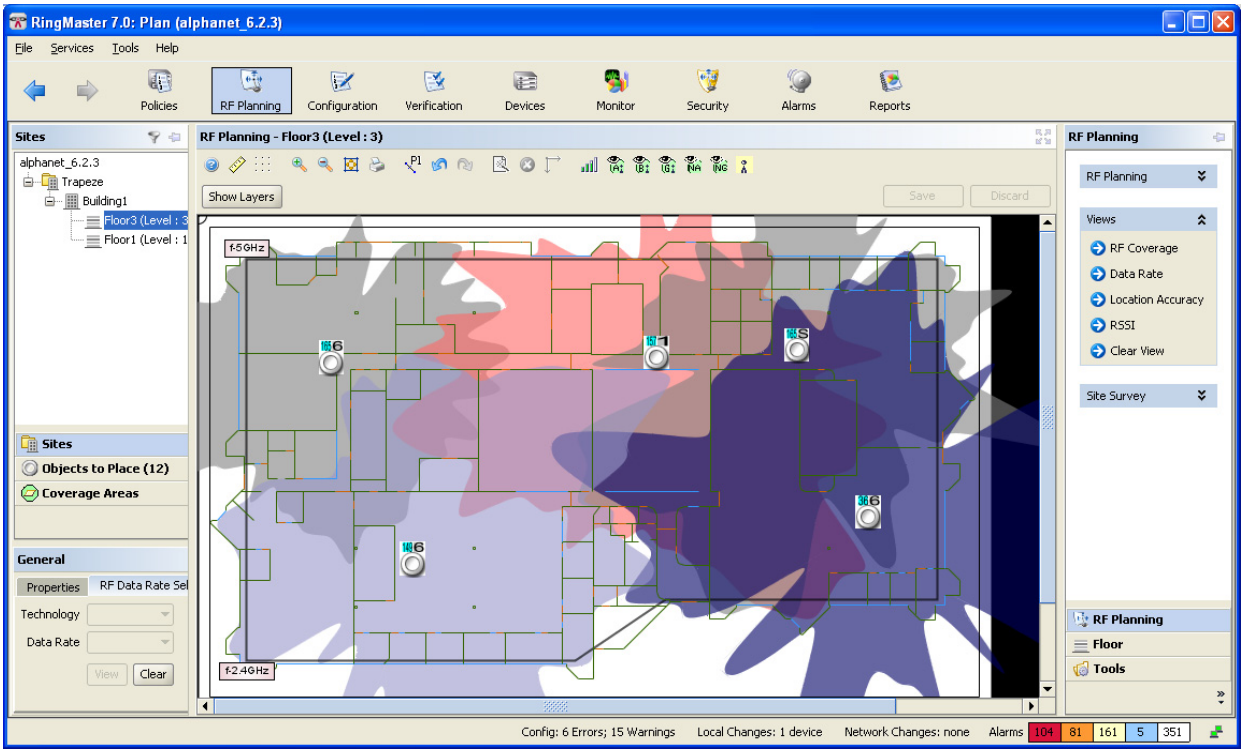
In a floor view, click on **Views > RF Coverage > (Select Technology)** and you will see somethong like the example below:



Steps After Using RF Planning Wizard

There are several steps typically required after the RF Planning wizard is finished.

These steps involve the following:

- **Update MX Configuration**
  Refer to Configuring MX System Parameters in the publication RingMaster 7.4 Configuration Guide.
- **Update AP Configuration**
  Refer to Viewing and Changing Access Point Settings in the publication RingMaster 7.4 Configuration Guide.
- **Deploy Configuration**
  Refer to Completing Configuration and Deploying in the publication RingMaster 7.4 Configuration Guide.
- **Generate Work Order**
  Refer to Generating a Site Survey Order or Generating an Ekahau Site Survey Work Order in this Guide.
- **Optimize RF Plan**
  Refer to Chapter , “Optimizing an RF Plan,” on page 1.

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Other Planning Processes

After you have created a network plan and sites with the RF Planning wizard, you can add and modify the plan. This chapter describes procedures for a number of “post-wizard” activities.

Descriptions in this chapter cover the following:

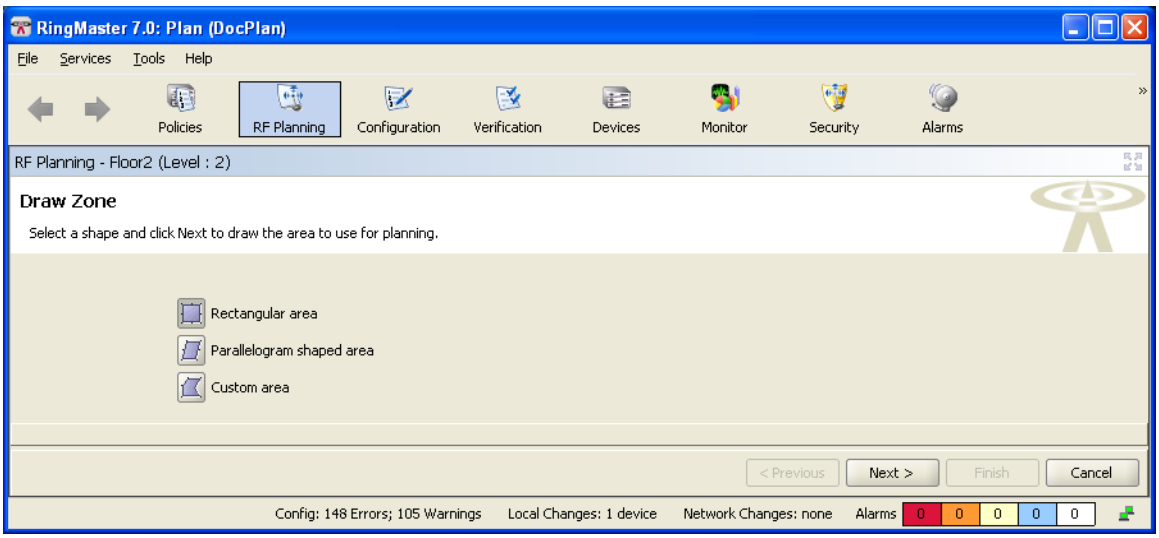
- **Zones**
- **Adding an AP to a Floor**
- **Editing Access Point Properties**
- **Changing an AP’s Model**
- **Adding Buildings and Floors to an Existing Site**
- **Importing a Drawing of a Floor**
- **Working with Drawings**
- **Creating RF Obstacles Manually**
- **RF Obstacle Library**
- **Shared Coverage Areas**
- **Generating a Site Survey Order**
- **Planning RF Coverage**

Zones

A Zone is an area where you want different settings than other areas in a network. RF zones allow planning of high capacity areas. You can deploy 802.11n as an overlay for areas having high utilization or coverage holes. You can deploy 802.11n at 5 GHz where the 2.4 GHz band suffers from high interference.

When you are viewing a floor and its coverage area(s) you can select **Create Zone** to see the following dialog:

1. Select an area type from the icons presented and click **Next**.



Your choices for zone drawings tools are:

- **Rectangular area**
- **Parallelogram shaped area**

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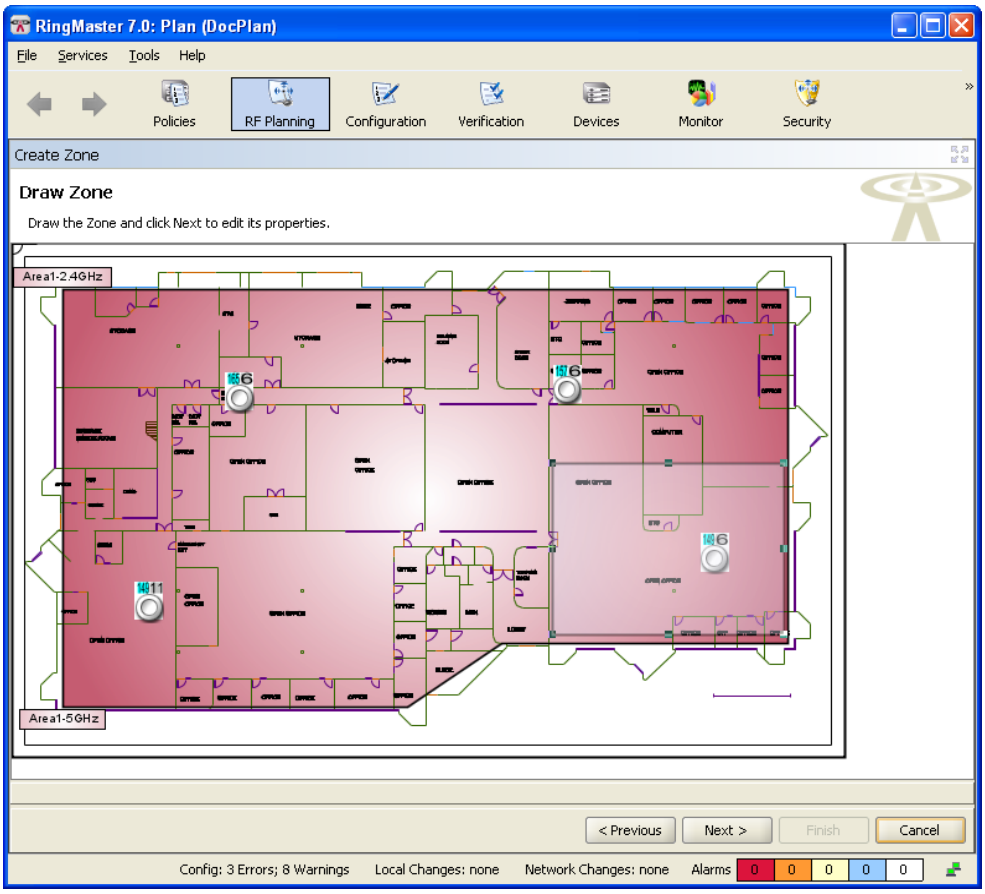
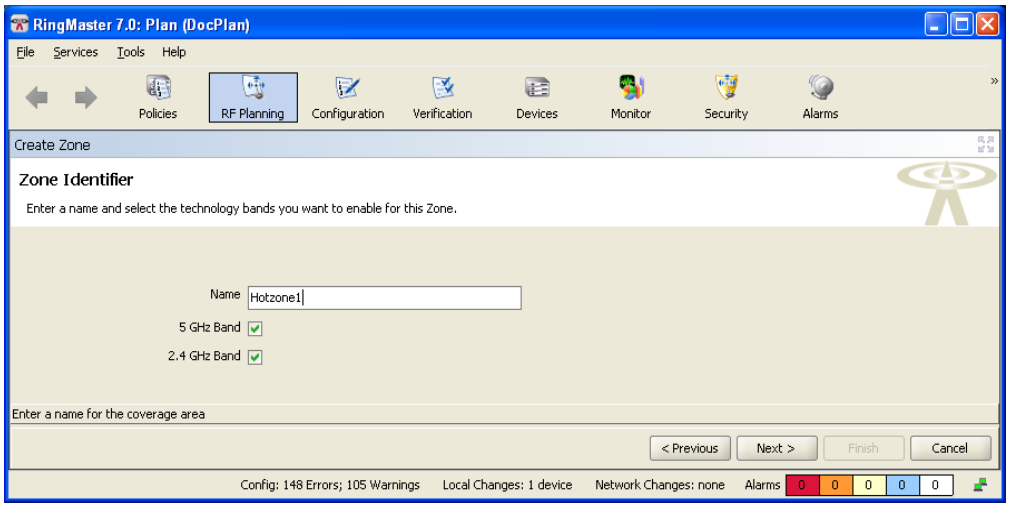
- **Custom area**

2. Draw a new zone and click **Next**.



3. Enter a name for the zone.



Select **5 GHz Band**, **2.4 GHz Band,** or both and then click **Next.**

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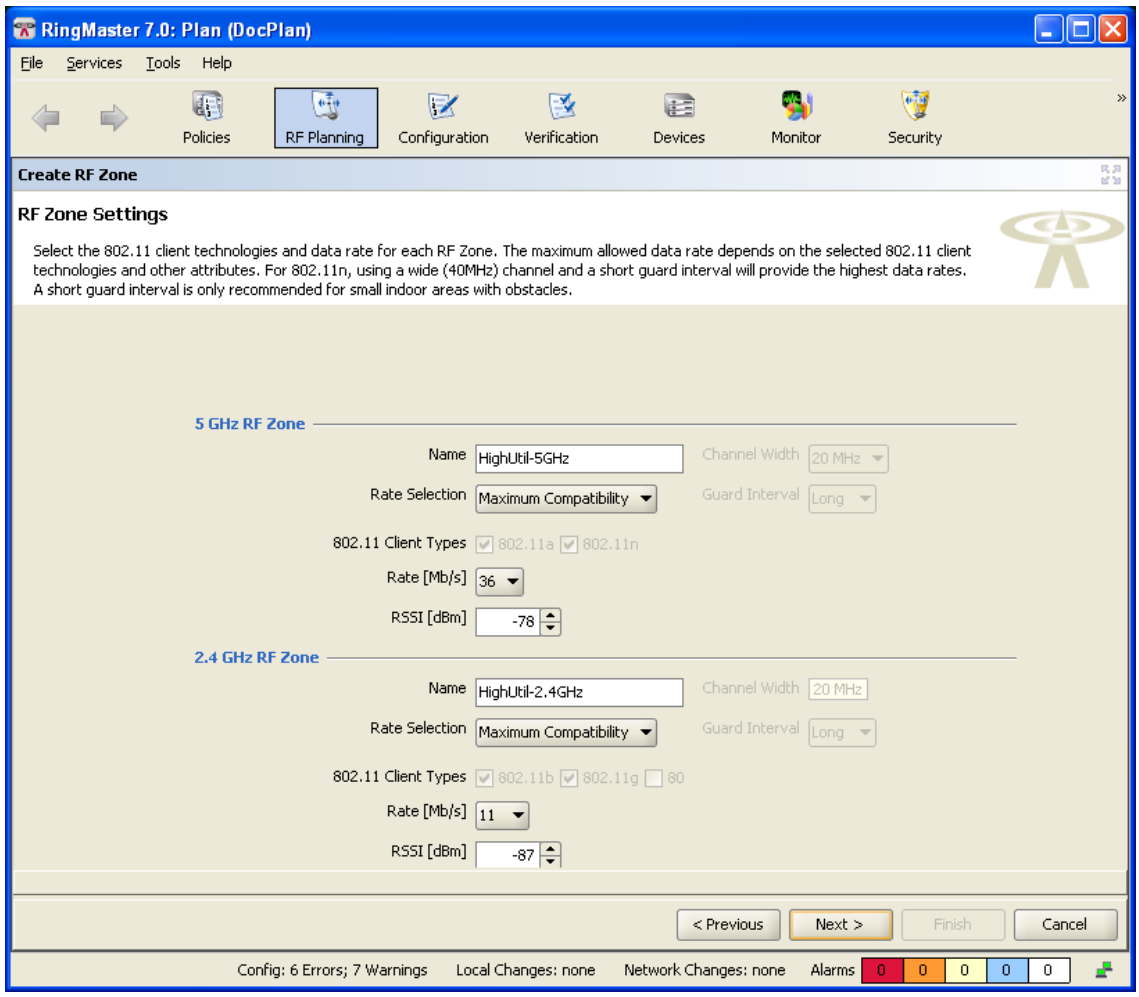
4. Configure zone settings as desired.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Policies
RF Planning
Configuration
Verification
Devices
Monitor
Security
Create RF Zone
RF Zone Settings
Select the 802.11 client technologies and data rate for each RF Zone. The maximum allowed data rate depends on the selected 802.11 client technologies and other attributes. For 802.11n, using a wide (40MHz) channel and a short guard interval will provide the highest data rates. A short guard interval is only recommended for small indoor areas with obstacles.
5 GHz RF Zone
Name HighUtil-5GHz
Channel Width 20 MHz
Rate Selection Maximum Compatibility
Guard Interval Long
802.11 Client Types 802.11a 802.11n
Rate [Mb/s] 36
RSSI [dBm] -78
2.4 GHz RF Zone
Name HighUtil-2.4GHz
Channel Width 20 MHz
Rate Selection Maximum Compatibility
Guard Interval Long
802.11 Client Types 802.11b 802.11g 80
Rate [Mb/s] 11
RSSI [dBm] -87
< Previous
Next >
Finish
Cancel
Config: 6 Errors; 7 Warnings
Local Changes: none
Network Changes: none
Alarms 0 0 0 0 0

Selections for the **5 GHz Zone** are as follows:

- **Name —** Enter a name
- **Rate Selection —** Select **Maximize Compatibility** or **Maximize Throughput**

  If Maximize Compatibility is selected, all 802.11 technologies will be selected to allow all clients. This limits overall throughput, as even though 802.11n is supported the data rate will be limited to legacy rates for compatibility. Also, 802.11n specific options like using wide channels and short guard intervals will be disabled.

  If Maximize Throughput is selected, only 802.11n is set as the supported technology type and all 802.11n optimizations will be leveraged to achieve the highest possible data rates.
- **802.11n Client Types —** Check boxes to select technologies used:
  - **802.11a**
  - **80.11n**
  - **Custom**

  Specify whether you want to support 802.11a and 802.11n clients. Selected types impact available data rates. For example, if 802.11a and 802.11n are both selected, the highest data rate you can use for planning is 54 Mbps. If only 802.11n is selected, the highest data rate you can use is 300 Mbps.
- **Rate [Mb/s]**

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This value specifies the desired data rate to use for RF planning. When the RF Planning wizard computes the number of APs required and chooses the best location for each AP, it aims to achieve the highest possible coverage of the area at the selected data rate. Hence, selecting a higher data rate results in more APs being placed. You can then visualize RF coverage at all data rates.

- **RSSI Value [dBm] —** Select desired value

  This value specifies the desired RSSI to use for RF Planning. It is directly related to the data rate, in a manner where changing one value will impact the other. If you specify an RSSI value, the lowest data rate required to achieve the RSSI will be configured.

- **Channel Width —** Select 20 or 40 MHz

  This option allows the use of 40 Mhz (wide) channels. Using wide channels will enable higher data rates.Guard Interval — Select Long or Short

- **Guard Interval —** Select Long or Short

  Using a short guard interval will enable slightly higher data rates (about 10%). A short guard interval is not recommended for outdoor areas, or large open indoor areas.

Selections for the **2.4 GHz Zone** are as follows:

- **Name —** Enter a name
- **Rate Selection —** Pull-down selects between 1 and 11 Mb/s
- **802.11n Client Types —** Check boxes to select technologies used:
  - **802.11a**
  - **80.11n**
  - **802.11b**
  - **802.11g**
  - **802.11**

  Selected types impact available data rates. For example, if 802.11a and 802.11n are both selected, the highest data rate you can use for planning is 54 Mbps. If only 802.11n is selected, the highest data rate you can use is 300 Mbps.

- **Rate [Mb/s] —**

  This value specifies the desired data rate to use for RF planning. When the RF Planning wizard computes the number of APs required and chooses the best location for each AP, it aims to achieve the highest possible coverage of the area at the selected data rate. Hence, selecting a higher data rate results in more APs being placed. You can then visualize RF coverage at all data rates.

- **RSSI Value [dBm] —** Select desired value

  This value specifies the desired RSSI to use for RF Planning. It is directly related to the data rate, in a manner where changing one value will impact the other. If you specify an RSSI value, the lowest data rate required to achieve the RSSI will be configured.

- **Channel Width —** Select 20 or 40 MHz

  This option allows the use of 40 Mhz (wide) channels. Using wide channels will enable higher data rates.

- **Guard Interval —** Select Long or Short

  Using a short guard interval will enable slightly higher data rates (about 10%). A short guard interval is not recommended for outdoor areas, or large open indoor areas.

Click **Next**.

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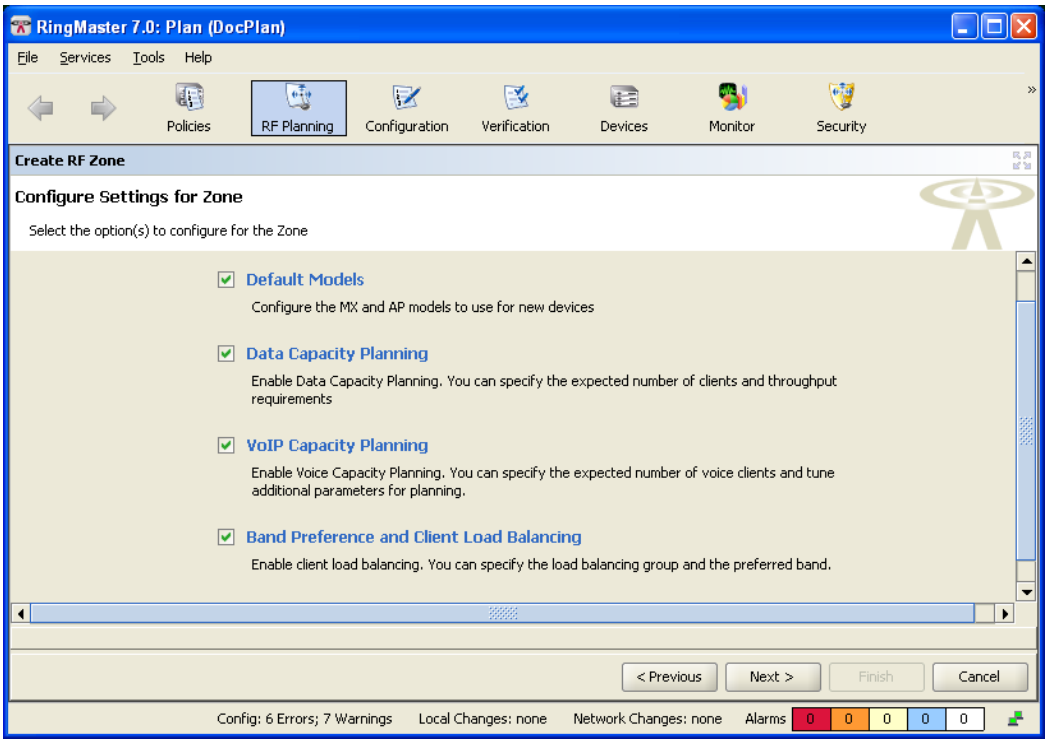
5. You now see the **Configure Settings for Zone** dialog where you can select options for continuing configuration using the wizard.



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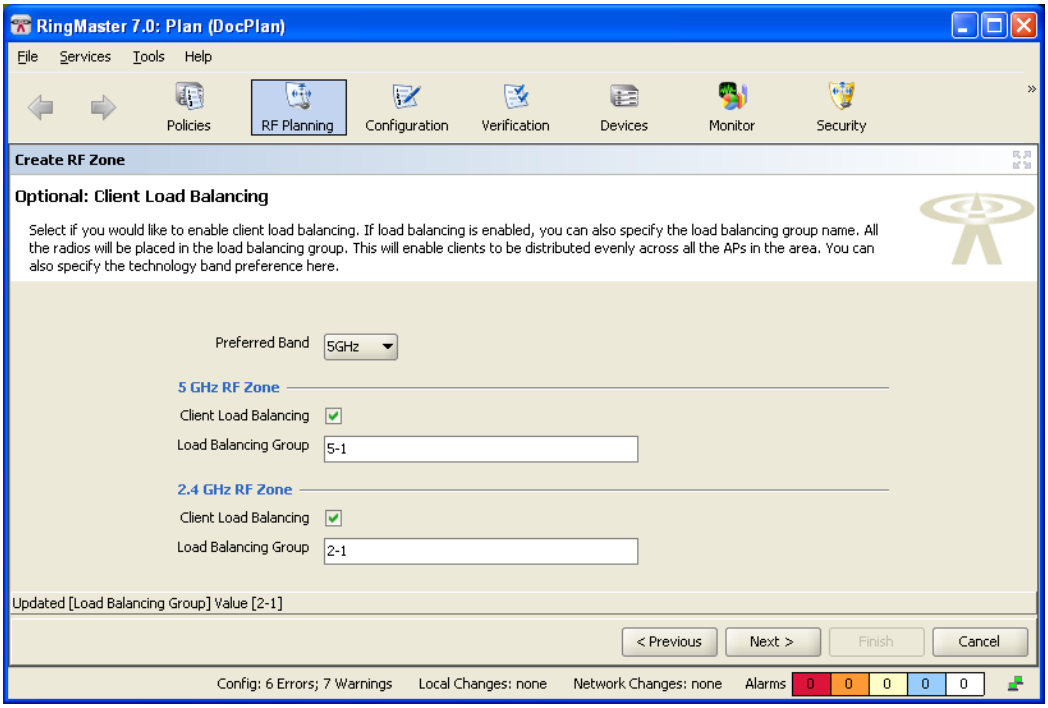
6. In the example above, all checboxes were selected, so you first see the **Optional: Default Models** dialog shown here:



Select Load Balancing if desired in one or bothe bands, enter group names and click **Next**.

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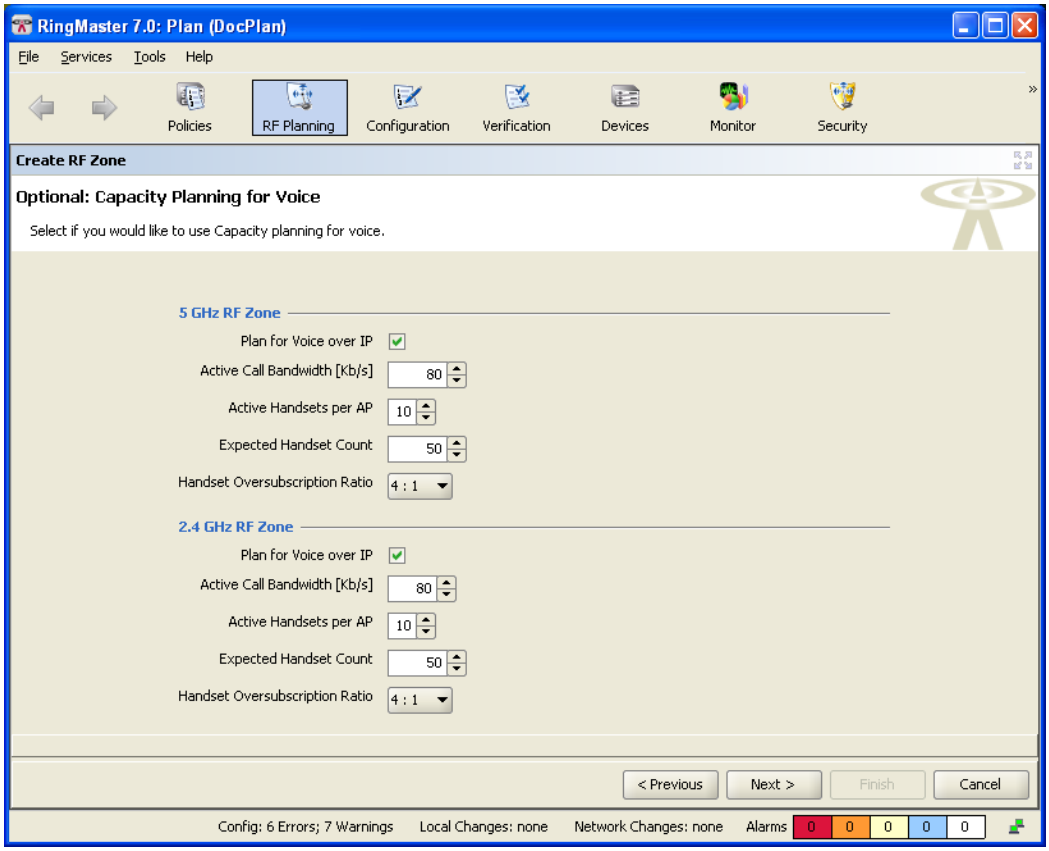
7. You now see the Optional: Capacity Planning for Voice dialog.



Make desired selections and click **Next**.

8. You now continue by seeing the Continue Planning? dialog with Compute and Place selected. This sequence is described in Chapter , “RingMaster’s RF Planning Wizard,” on page 25.

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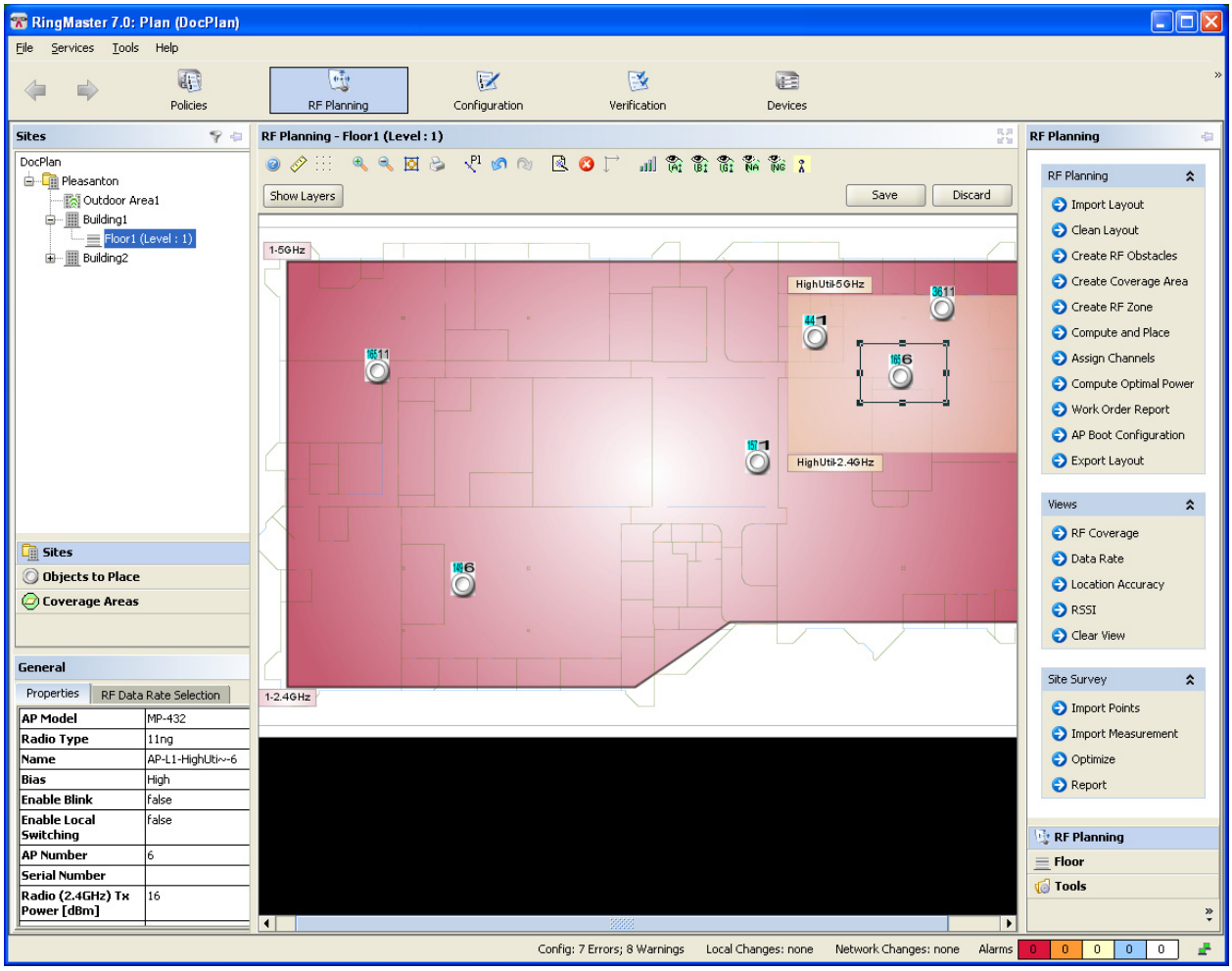
9. Your new zone appears on the floor plan and its properties can be viewed and changed in the normal fashion for zones and coverage areas.



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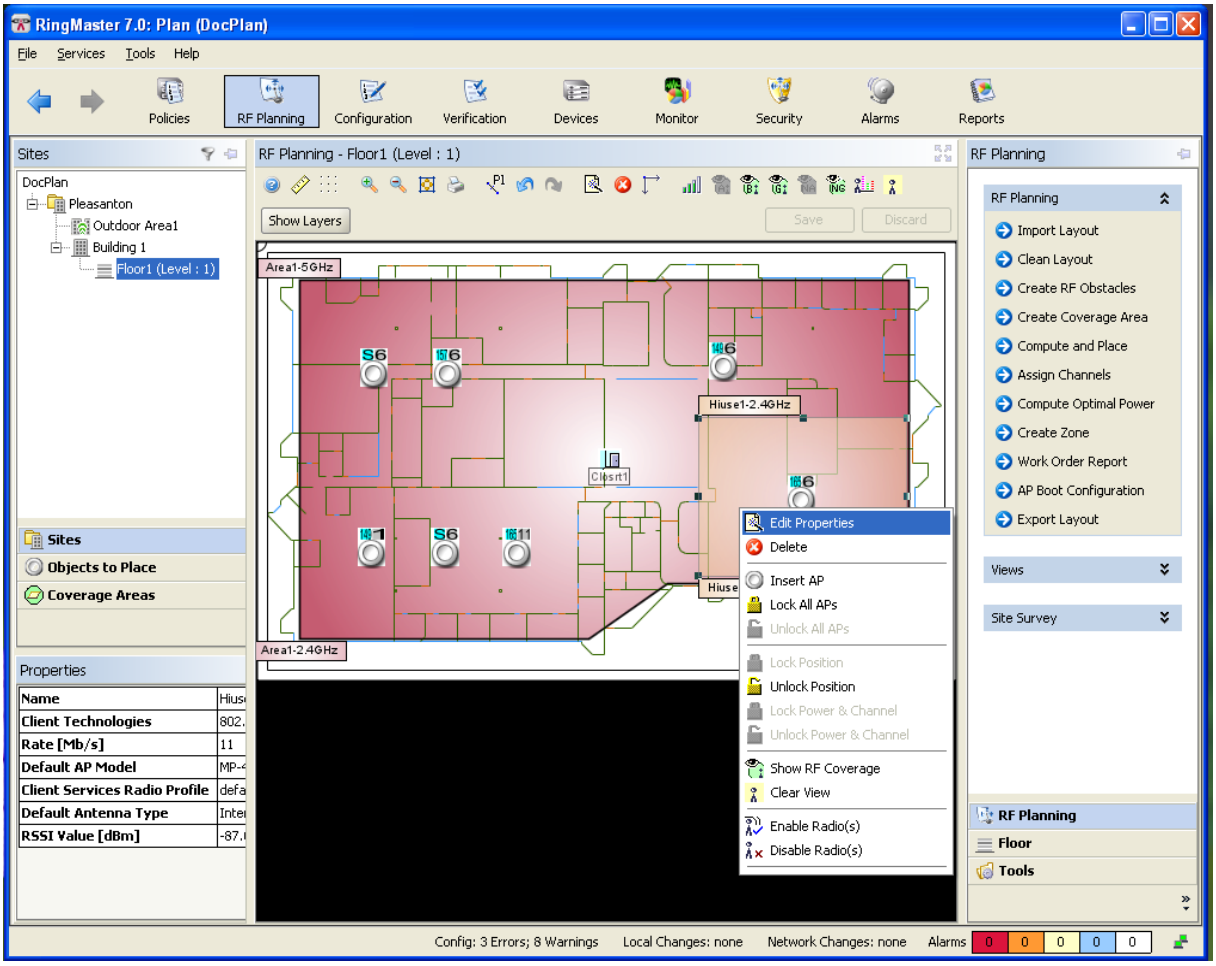
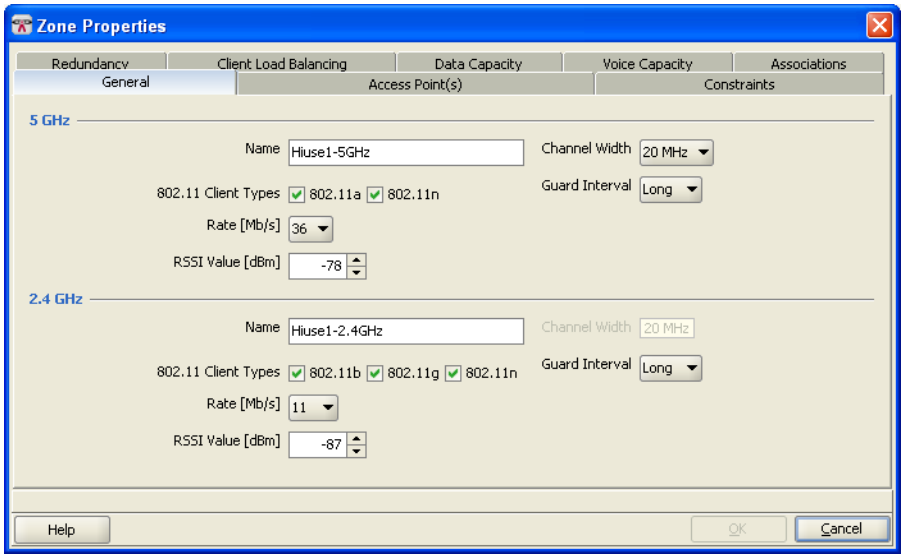
Editing Zone Properties

1. If you right click on a zone, you can select the **Edit Properties** item as shown below:



2. This brings up the **Zone Properties** (multi-tabbed) dialog where you can set or change zone properties. The illustration below shows the **General** tab of the **Zone Properties** dialog.



The **5 GHz** area of the **General** tab includes the following:

- **Name** — Accept or enter the name of this zone
- **802.11 Client Types** — Click to select 802.11a, 802.11n, or both
- **Rate [Mb/s]** — Select a rate from pull-down
- **RSSI Value [dBm]** — Select a value from pull-down
- **Channel Width** — Select a value from pull-down
- **Guard Interval** — Select a value from pull-down

The **2.4 GHz** area of the **General** tab includes the following:

- **Name** — Accept or enter the name of this zone
- **802.11 Client Types** — Click to select 802.11a, 802.11n, or both
- **Rate [Mb/s]** — Select a rate from pull-down
- **RSSI Value [dBm]** — Select a value from pull-down
- **Channel Width** — Set at 20 MHz
- **Guard Interval** — Select a value from pull-down

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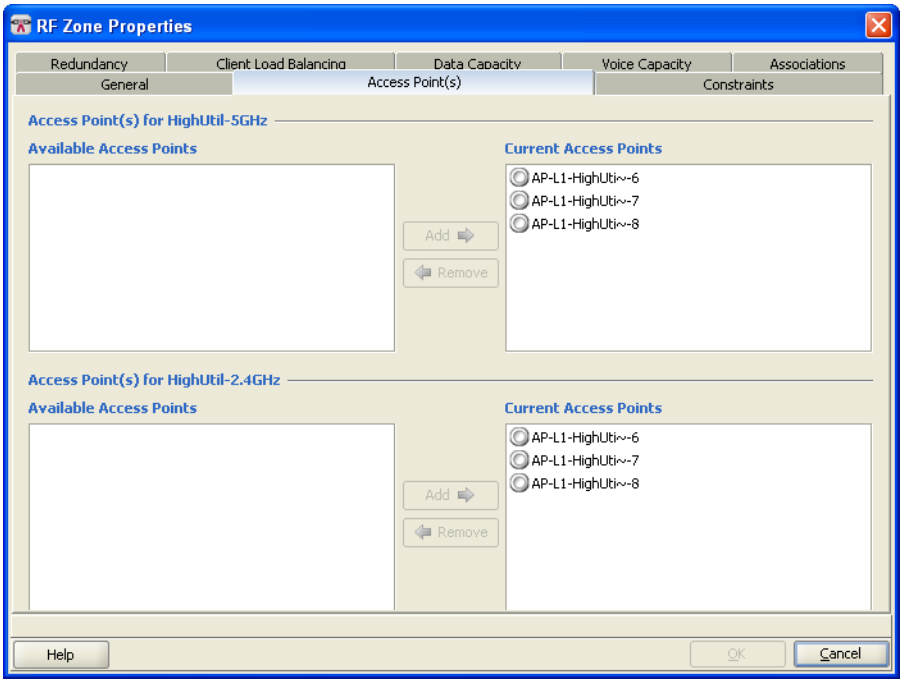
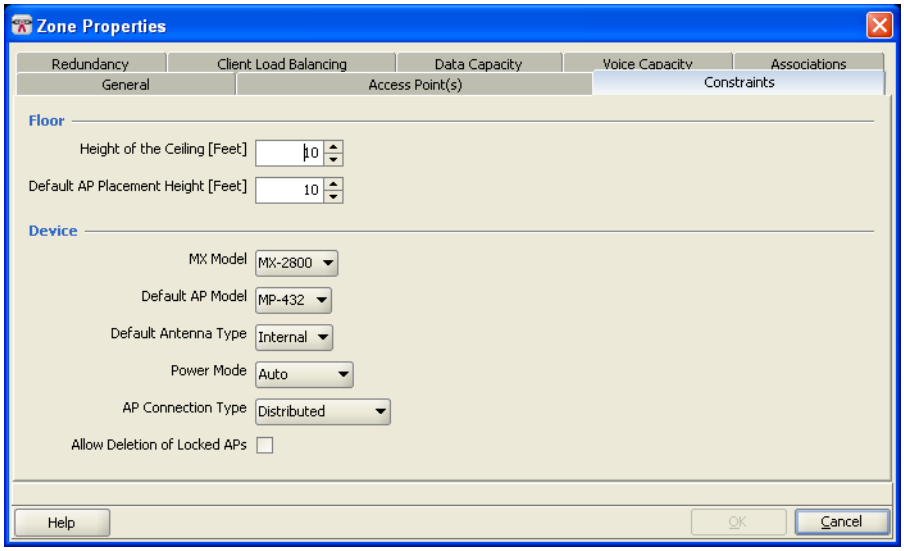
3. The illustration below shows the **Access Point(s)** tab of the **Zone Properties** dialog.



This dialog allows you to control the access points in a zone by adding and removing **Available Access Points** from the list of **Current Access Points** in both 5 GHz and 2.4 GHz zones.

4. The illustration below shows the **Constraints** tab of the **Zone Properties** dialog



The **Floor** area of this dialog allows you to set the following:

- **Height of Ceiling [Feet]**
- **Default AP Placement Height [Feet]**

The **Device** area of this dialog allow you to set the following:

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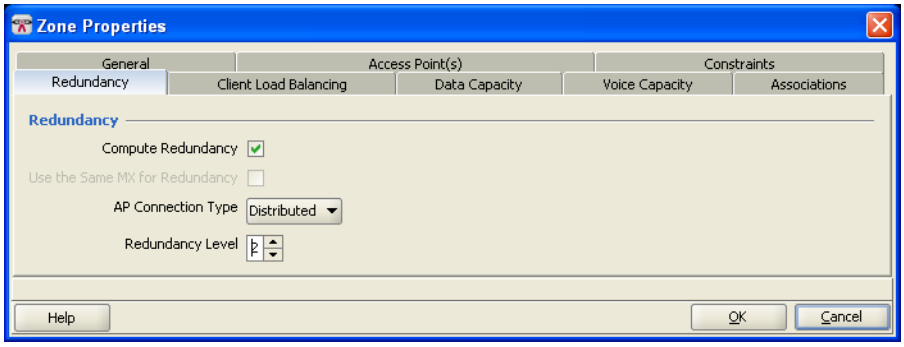
- **MX Model —** Pull-down list
- **Default AP Model —** Pull-down list
- **Default Antenna Type —** Pull-down list
- **Power Mode —** Pull-down list
- **AP Connection Type —** Pull-down list
- **Allow Detection of Locked APs —** Check box

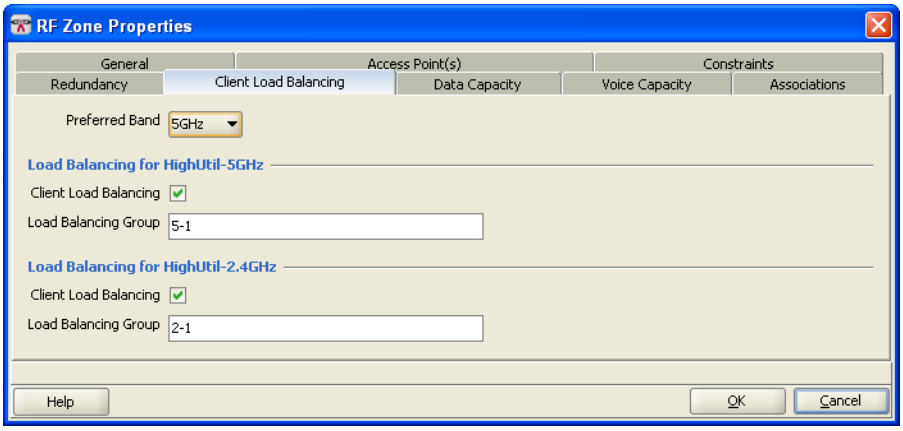
5. The illustration below shows the **Redundancy** tab of the **Zone Properties** dialog



This dialog contains the following settings:

- **Compute Redundancy —** Check box
- **Use the Same MX for Redundancy —** Check box
- **AP Connection Type —** Select **Direct** or **Distributed** from pull-down.
- **Redundancy Level** — Enter or select a value.

6. The illustration below shows the **Client Load Balancing** tab of the **Zone Properties** dialog



The upper area of this dialog allows you to set the following:

- **Preferred Band —** This band will be the basis of computations.

The **Load Balancing for (*zonename*)-5GHz** area allows you to set the following:

- **Client Load Balancing —** Check box
- **Load Balancing Group** — Enter or leave the name.

The **Load Balancing for (*zonename*)-2.4GHz** area allows you to set the following:

- **Client Load Balancing —** Check box
- **Load Balancing Group** — Enter or leave the name.

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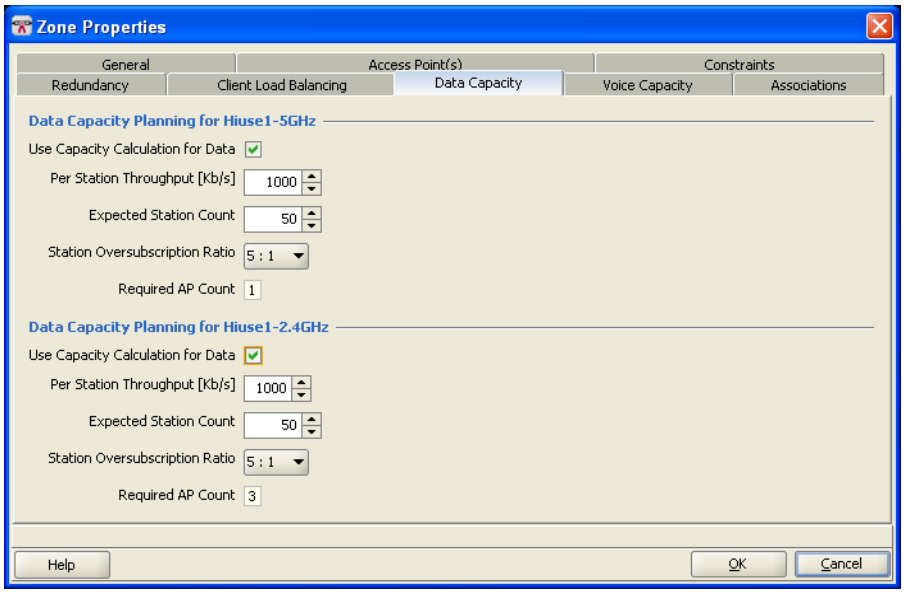
7. The illustration below shows the **Data Capacity** tab of the **Zone Properties** dialog



The **Data Capacity Planning for (*zonename*)-5GHz** area allows you to set the following:

- **Use Capacity Calculation for Data —** Check box
- **Per Station Throughput [Kb/s] —** Enter or select a value
- **Expected Station Count —** Enter or select a value
- **Station Oversubscription Ratio —** Select a value from pull-down
- **Required AP Count —** Value provided by *RingMaster* software.

The **Data Capacity Planning for (*zonename*)-2.4GHz** area allows you to set the following:

- **Use Capacity Calculation for Data — Check box**
- **Per Station Throughput [Kb/s] —** Enter or select a value
- **Expected Station Count —** Enter or select a value
- **Station Oversubscription Ratio —** Select a value from pull-down
- **Required AP Count —** Value provided by *RingMaster* software.

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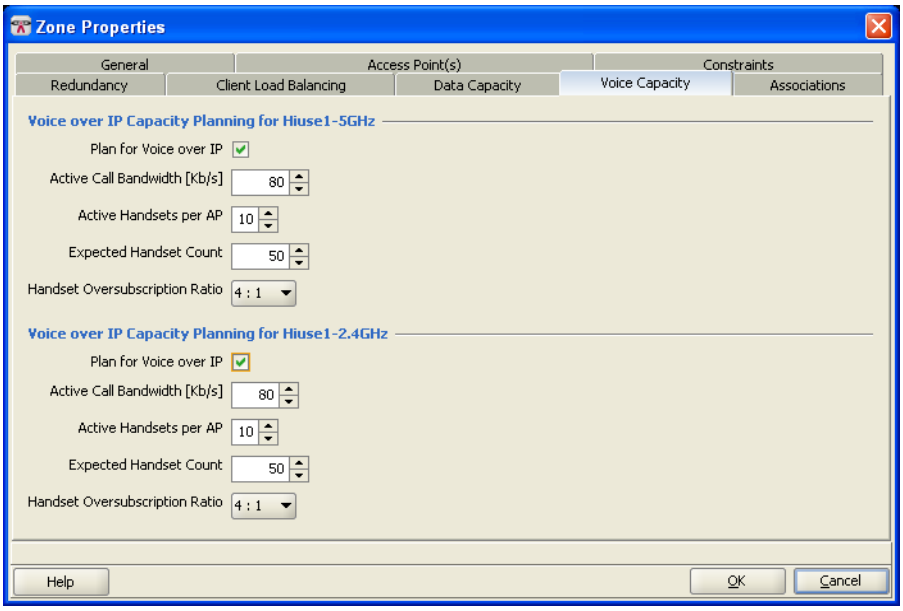
8. The illustration below shows the **Voice Capacity** tab of the **Zone Properties** dialog



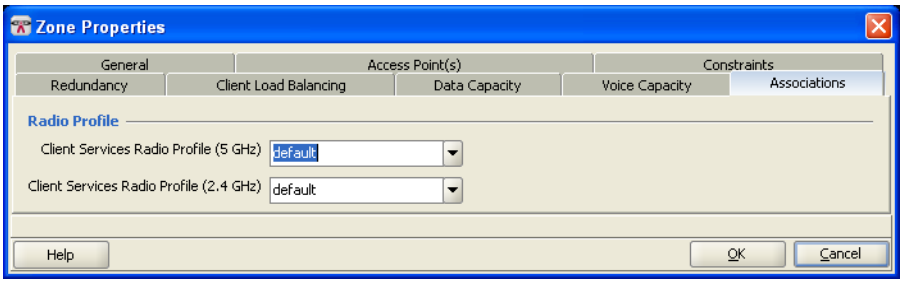
The **Voice over IP Capacity Planning for (*zonename*)-5GHz** area allows you to set:

- **Plan for Voice over IP —** Check box
- **Active Call Bandwidth [Kb/s] —** Enter or select a value
- **Active Handsets per AP —** Enter or select a value
- **Handset Oversubscription Ratio —** Select a value from pull-down

The **Voice over IP Capacity Planning for (*zonename*)-2.4GHz** area allows you to set:

- **Plan for Voice over IP — Check box**
- **Active Call Bandwidth [Kb/s] —** Enter or select a value
- **Active Handsets per AP —** Enter or select a value
- **Handset Oversubscription Ratio —** Select a value from pull-down

9. The illustration below shows the **Associations** tab of the **Zone Properties** dialog



This dialog allows the following settings:

- **Client Services Radio Profile (5 GHz)** — Select from pull-down
- **Cient Services Radio Profile (2.4 GHz)** — Select from pull-down

Adding an AP to a Floor

To add a Model MP-432 (802.11n) AP to a site:

1. Click the **Configuration** icon on the Navigation Bar.

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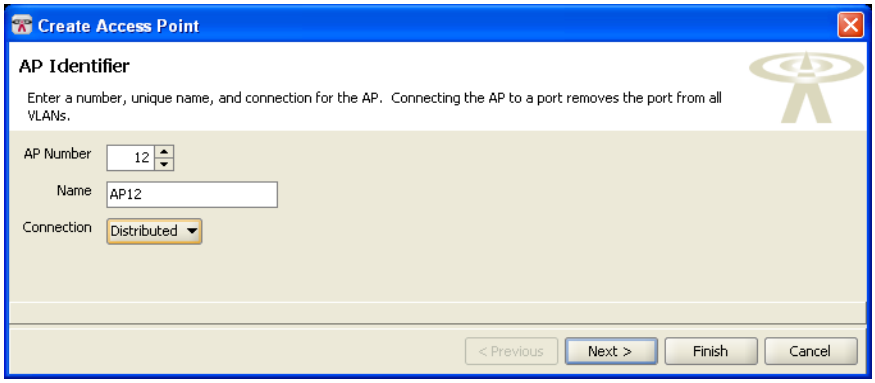
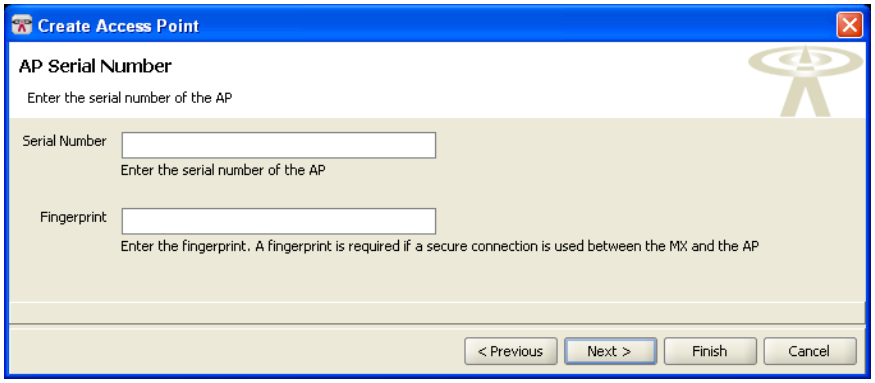
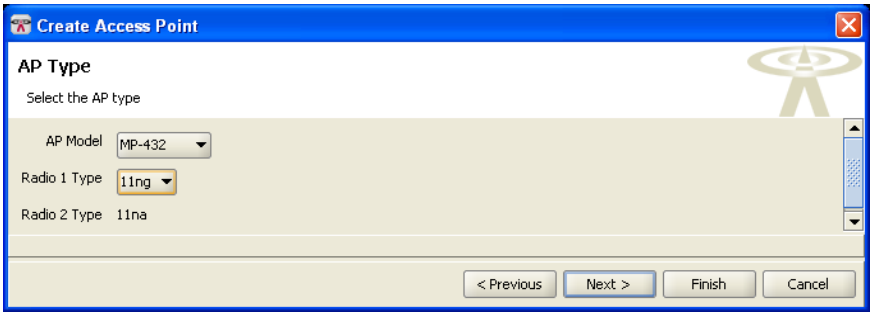
2. Click on the plus sign adjacent an MX in the **Organizer** panel.
3. Select **Wireless** and then **Access Points**.
4. In the **Tasks** panel, click **Create > AP**.
5. You see the dialog below. Select an **AP Number** and enter a **Name**. Use the pull-down to select Distributed or port AP **Connection**. Click **Next**.



6. In the **AP Serial Number** dialog, enter the new AP's **Serial Number** and enter a **Fingerprint** if a secure MX connection will be used. Click **Next**.


Create Access Point
AP Serial Number
Enter the serial number of the AP
Serial Number
Enter the serial number of the AP
Fingerprint
Enter the fingerprint. A fingerprint is required if a secure connection is used between the MX and the AP
< Previous
Next >
Finish
Cancel

7. Select **AP Model** MP-432 from the pull-down and select **Radio Type** 11b or 11ng. Click **Next**.



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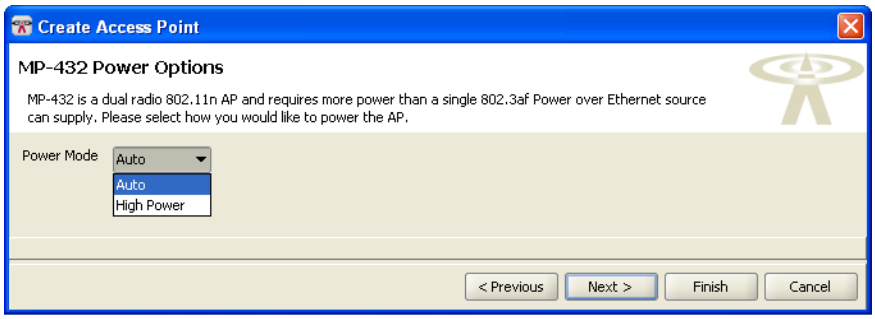
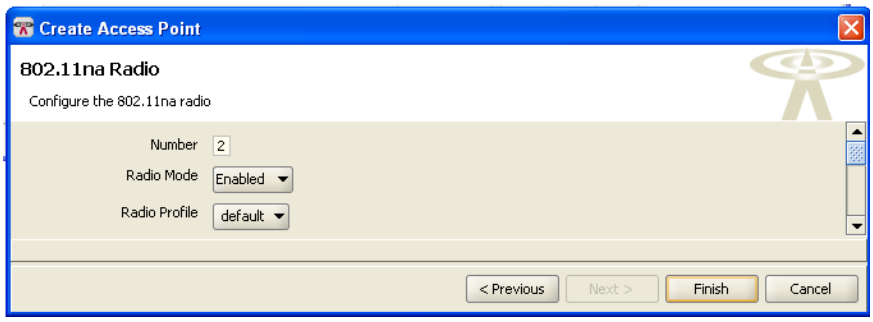
8. Select a **Power Mode** from the pull-down and click **Next**.


Create Access Point
MP-432 Power Options
MP-432 is a dual radio 802.11n AP and requires more power than a single 802.3af Power over Ethernet source can supply. Please select how you would like to power the AP.
Power Mode
Auto
Auto
High Power
< Previous
Next >
Finish
Cancel

9. Select **Radio Mode** and **Radio Profile** for the 802.11na radio from pull-downs and then click **Finish**.



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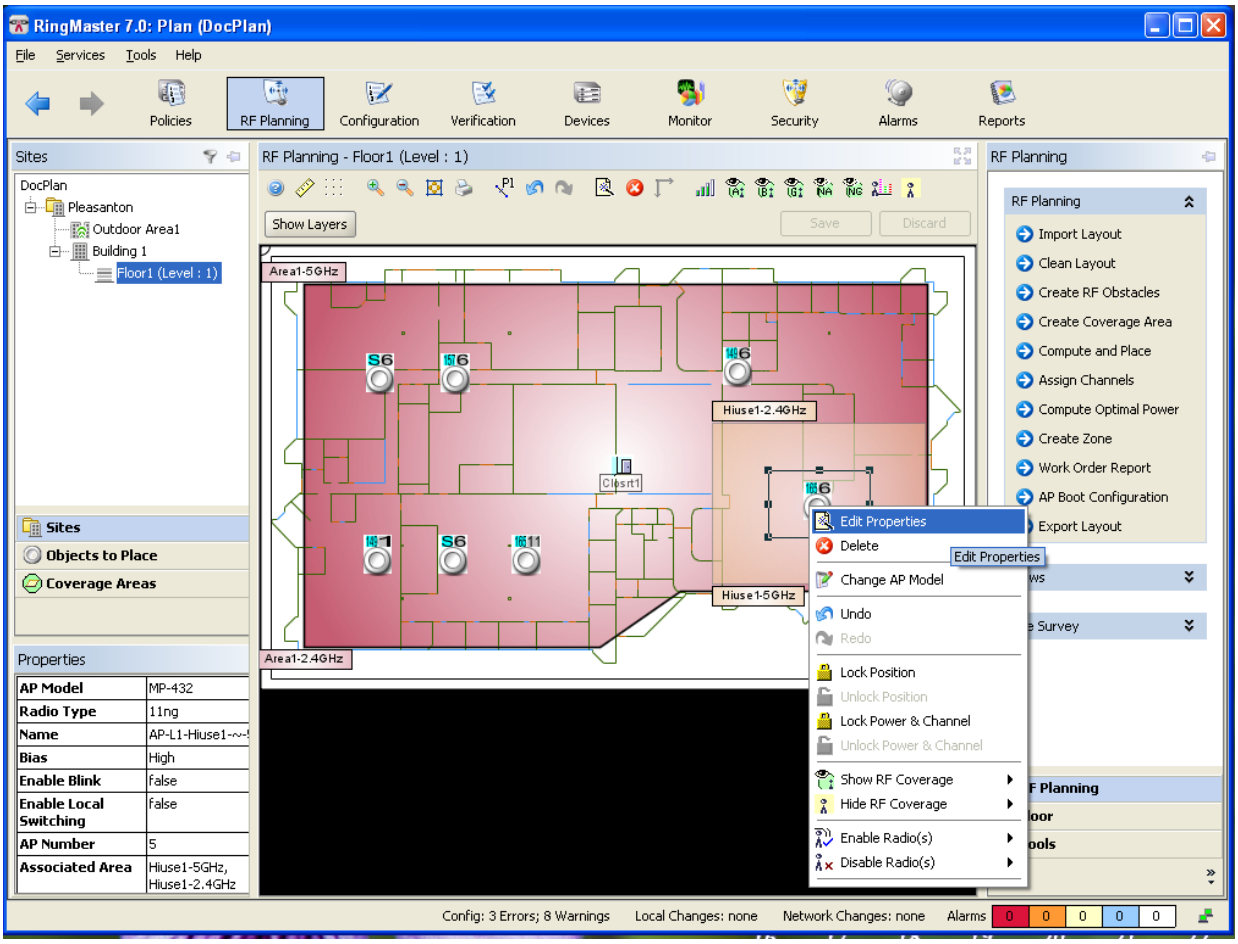
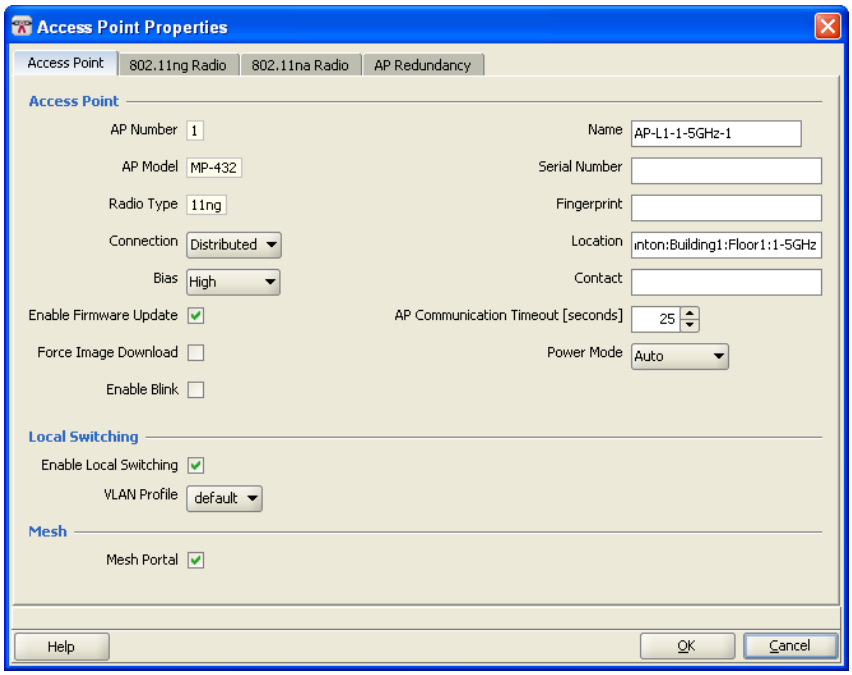
Editing Access Point Properties

1. If you right click on an AP, you can select the **Edit Properties** item as shown below:



2. This brings up the **Access Point Properties** (multi-tabbed) dialog where you can set or change AP properties.



The **Access Point** tab of this dialog shows you general AP settings.

The **Access Point** area of the **Access Point** tab includes the following:

- **Number** — Assigned AP number
- **Model** — AP model
- **Radio Type** — AP radio type
- **Connection** — Shown as **Distributed** in the example.
- **Enable Firmware Update** — Click on the check box to select.
- **Force Image Download** — Click on the check box to select.
- **Enable Blink** — Click on the check box to select.
- **Name** — This is provided and may be changed.
- **Serial Number** — Enter or accept.
- **Fingerprint** — Enter or accept.
- **Location** — This is provided and may be changed.
- **Contact** — Trouble contact number.
- **AP Communication Timeout (seconds)** — Select or enter a value for timeout interval.
- **Power Mode** — Select **Auto** or **High Power**.

The **Local Switching** area of this tab includes the following:

- **Enable Local Switching** — Click check box to enable.
- **VLAN Profile** — Select or use default.

The **Mesh** area of this tab includes the following:

- **Mesh Portal** — Select check box to enable.

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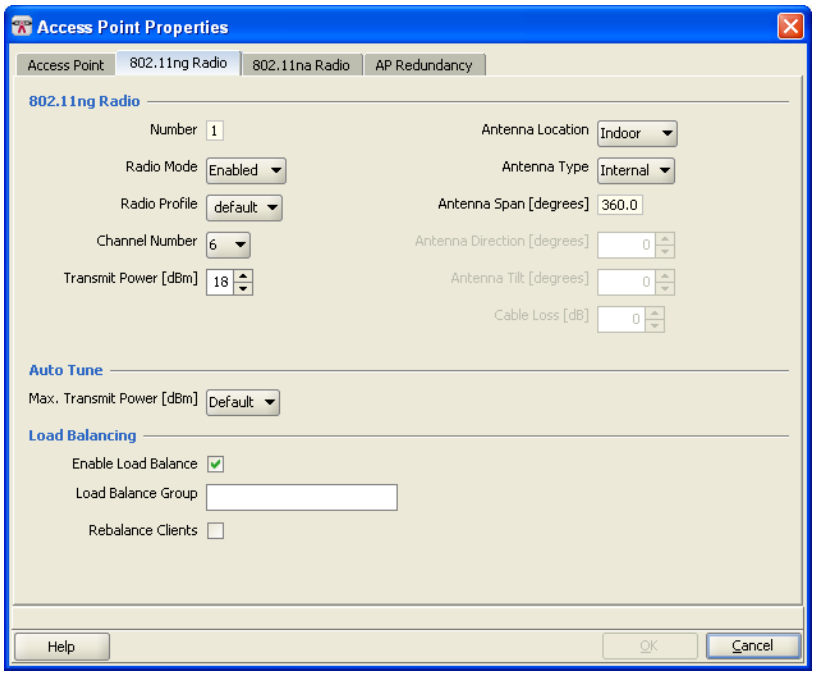
3. The **802.11ng Radio** tab of the **Access Point Properties** dialog shows you Radio 1 settings.



The **802.11ng Radio** area of the **802.11ng Radio** tab includes the following:

- **Number** — Radio number
- **Radio Mode** — Select **Enabled**, **Disabled**, or **Sentry**
- **Radio Profile** — Select from pull-down menu
- **Channel Number** — Select from pull-down menu
- **Transmit Power [dBm]** — Enter or select a value
- **Antenna Location** — Select **Indoor** or **Outdoor** from pull-down menu
- **Antenna Type** — Select from pull-down menu
- **Antenna Span [degrees]** — Value provided based on selection.
- **Antenna Direction [degrees]** — Enter or select a value
- **Antenna Tilt [degrees]** — Enter or select a value
- **Cable Loss [dB]** — Enter or select a value

The **Auto Tune** area of the **802.11ng Radio** tab includes the following:

- **Max. Transmit Power [dBm]** — Select from pull-down menu

The **Load Balancing** area of the **802.11ng Radio** tab includes the following:

- **Load Balance Group** — Enter a name
- **Rebalance Clients** — Select check box to enable.

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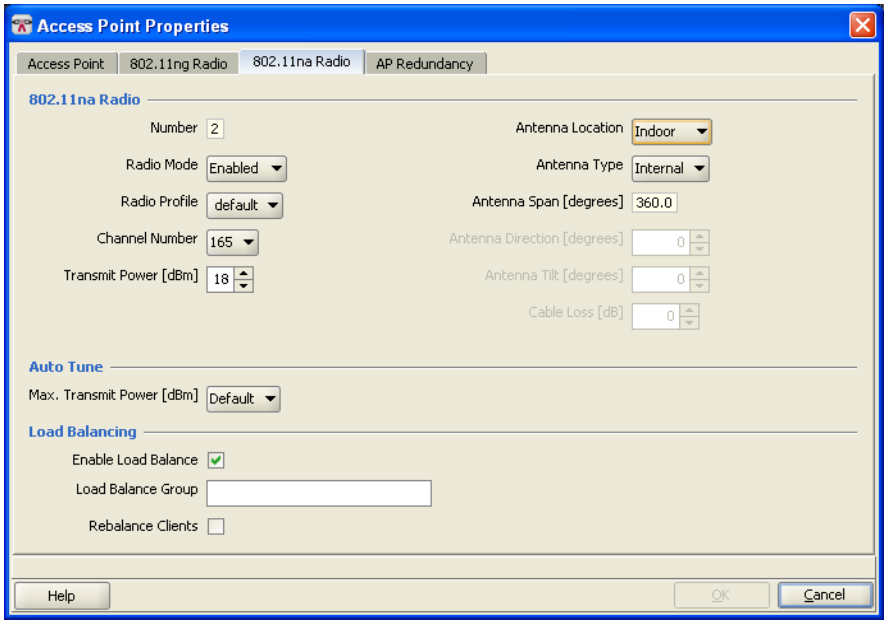
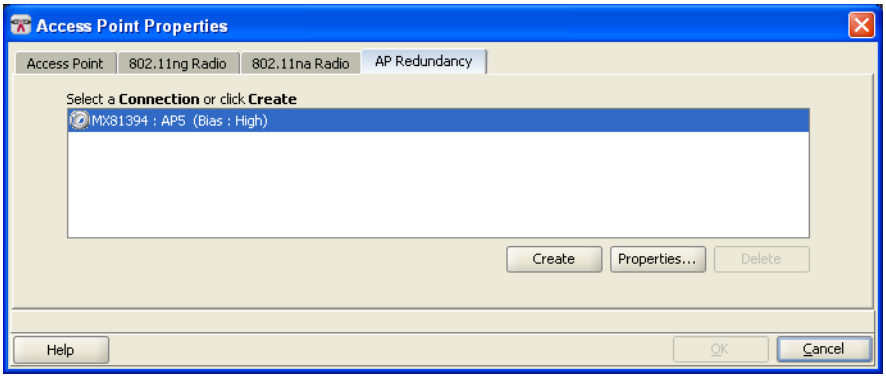
4. The **802.11na Radio** tab of the **Access Point Properties** dialog shows you Radio 2 settings.

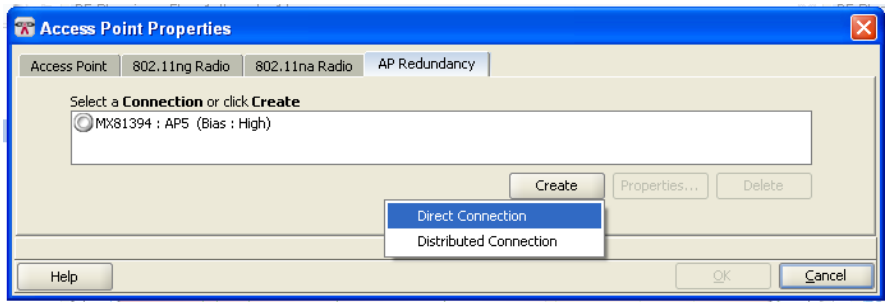


Areas in this dialog repeat the settings for Radio 2 that are described above for Radio 1.

5. The **AP Redundancy** tab of the **Access Point Properties** dialog shows you the dialog below.



6. Select **Create** to select to select **Direct Connection** or **Distributed Connection**:



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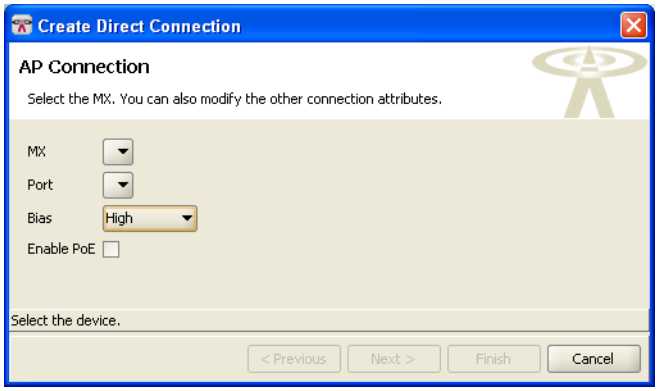
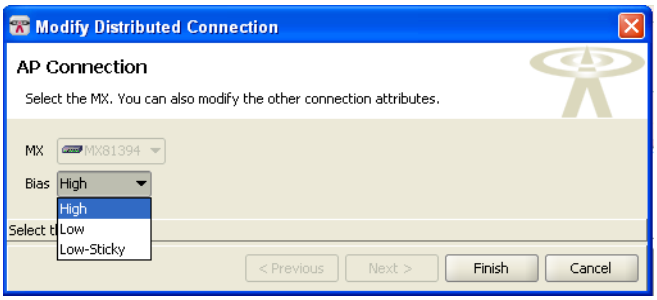
You will the see a dialog used to select an **MX**, **Port** and **Bias**, and to **Enable PoE**:



7. If you select an existing connection in the dialog of step 6, you see the following dialog:



You can select MXs and change their bias using this dialog. Click **Finish**.

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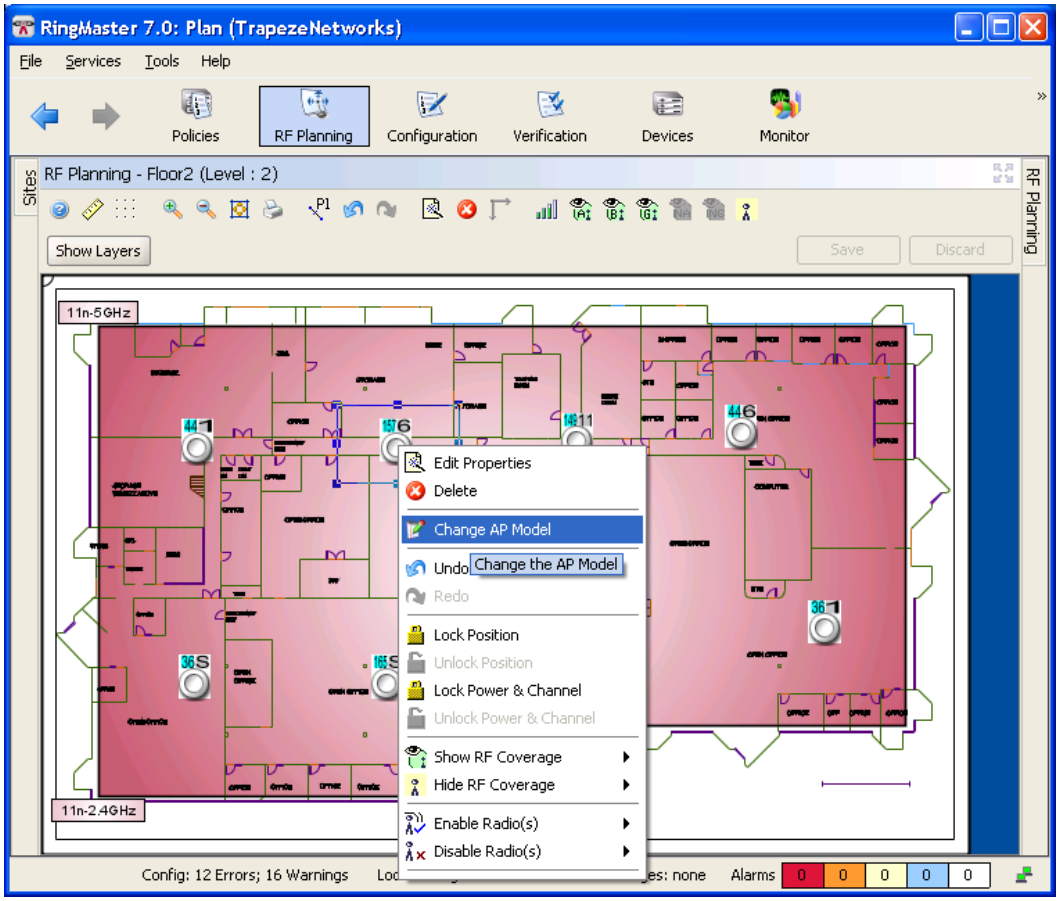
Changing an AP's Model

To change an AP's model, simply select the AP, and use the context menu (available via a right-click) to launch a task that will allow you to change the APs model. Once you have change the APs model, you can visualize its coverage on the RF Plan.



Replacing an AP can also be done by placing one AP over another one on the floor.

Change AP Model Wizard

RingMaster also provides a wizard to help replace all APs on a floor or coverage area or floor.

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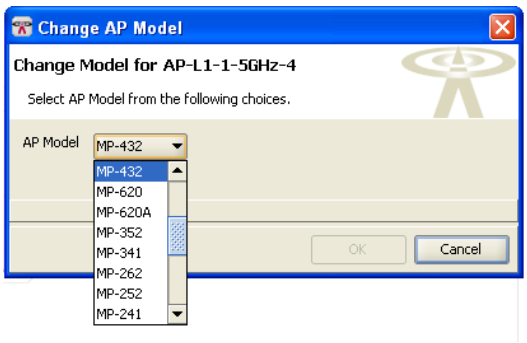
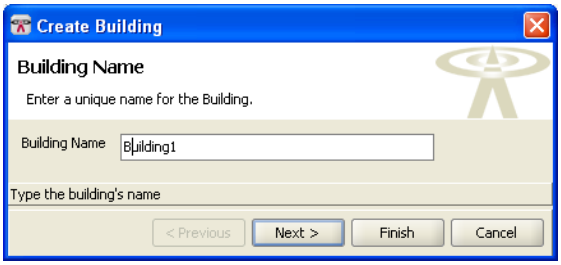
1. To launch this wizard, click on a floor map and select **Change Clients Technology** on the **Tasks** panel. This will launch a wizard used to specify a default AP model and provide an option to convert all existing AP models.



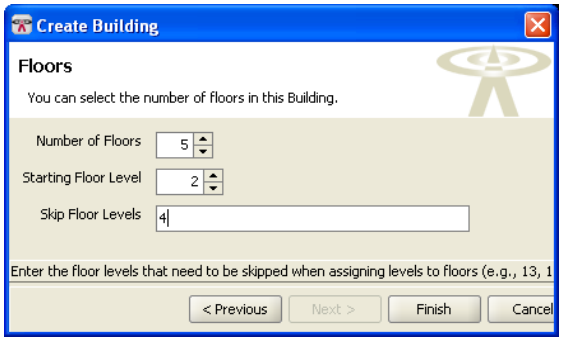
Adding Buildings and Floors to an Existing Site

You can add buildings to a site as follows:

1. In the **Organizer** panel, click the site name.
2. Select **Create Building** in the **Tasks** panel. The **Create Building** dialog prompts for information about a new building.



In the **Building Name** dialog **Building Name** field, type the name of the building (1 to 30 alphanumeric characters, with no spaces or tabs), and click **Next**.



3. In the **Number Of Floors** field, specify the number of floors in a building. When you specify this, *RingMaster* creates floors using default settings. You edit floors *RingMaster* creates or you add new floors.
4. In the **Starting Floor Level** field, specify a floor number for each floor in a building. To start with a basement or subterranean floor, you specify 0 or a negative floor number.

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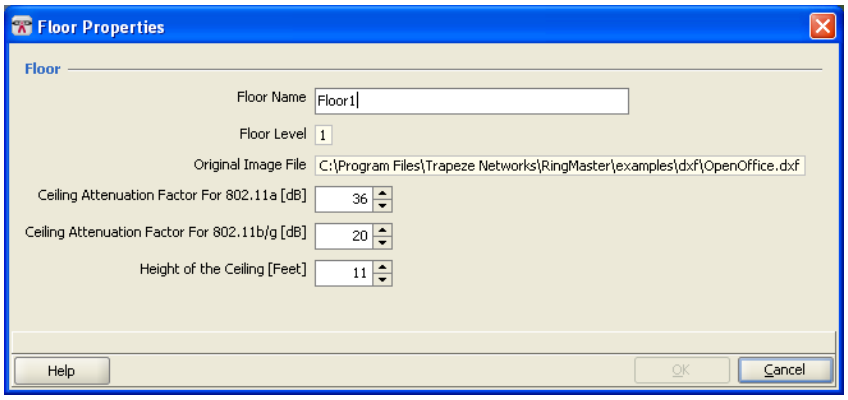
5. In the **Skip Floor Levels** field, specify floor numbers you want to skip. Skipping floors is useful when you do not want to model all floors in a building. Use commas to separate floor numbers in a list — like 1,3,7. Use a hyphen when entering a range — for example: 8-12.
6. Click **Finish** to close the dialog.

Adding a Floor to a Building

To create or modify a floor in a building:

1. Select the **RF Planning** Navigation Bar button.
2. In the **Organizer** panel, click the building name.
3. Do one of the following:
   - If you are creating a new floor, click on the building name in the **Organizer** panel and select **Create Floor** in the **Tasks** panel. A series of dialog boxes prompts you for information about the new floor.
   - If you are modifying an existing floor, click on a building name in the **Organizer** panel and then select a floor name in the **Content** panel for the building, then click **Properties**. Edit the properties of the floor. The following figure illustrates the information displayed in the **Floor Properties** dialog box for a floor.



4. To change a floor name, type the new name in the **Floor Name** field (1 to 60 alphanumeric characters, with no tabs). Each floor name in a building must be unique.
5. To change the default ceiling attenuation factor for the radio technology type, type the number of dB in the **802.11a (dB)** field or **802.11b/g (dB**) field.
6. In the **Height of the Ceiling** field, type the number of feet or meters from the floor to the ceiling (1 to 1000 feet or meters).

Click **OK.**

Adding Multiple Floors to a Building

The preferred manner of adding floors to a building is by using the **Create Floor** item in the **Tasks** panel after selecting a building in the **Organizer** panel. The alternate method described in this section achieves the same result.

The **Organizer** panel shows the buildings and floors you specified when adding the site.

You can edit floor information later as follows:

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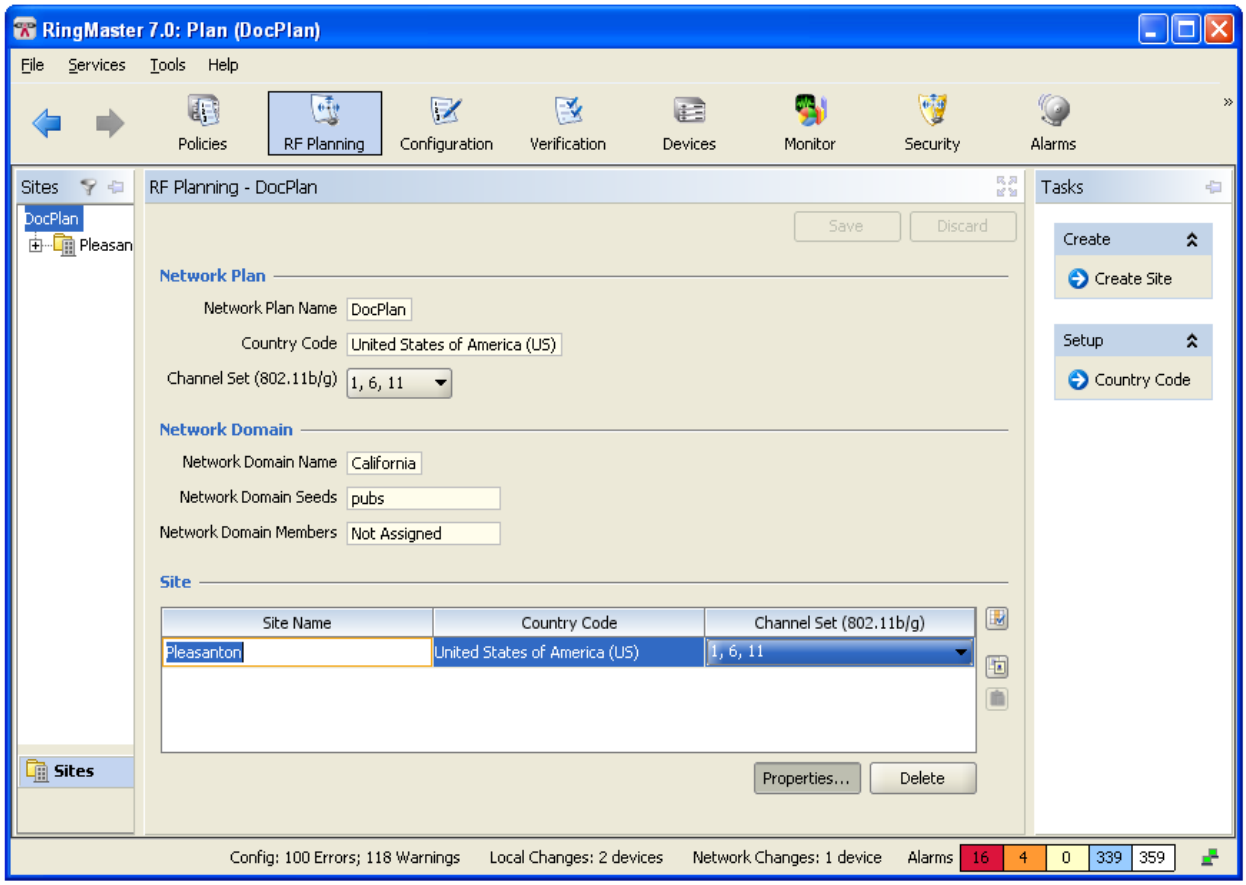
1. In the **Content** panel, click the **Network Plan** name. Highlight the **Name** by clicking on it, then click **Properties...**.



As an option, you can select a **Site** in the **Organizer** panel and click **Site Properties** in the **Tasks** panel. Either method brings up the same dialog box for you to use.

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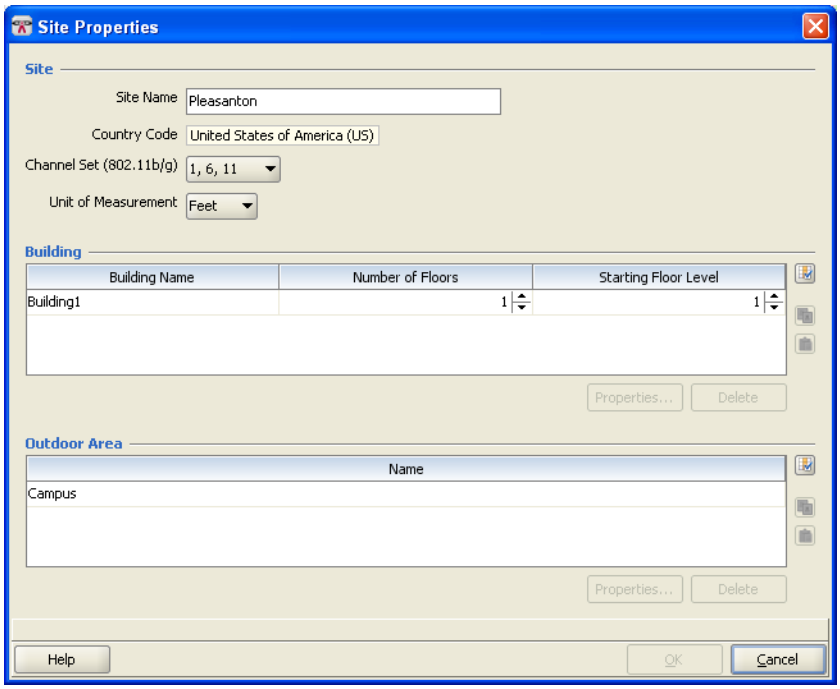
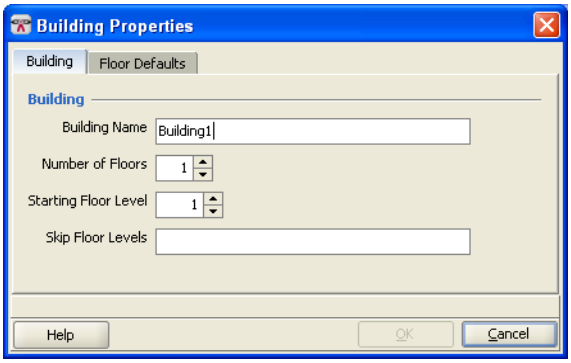
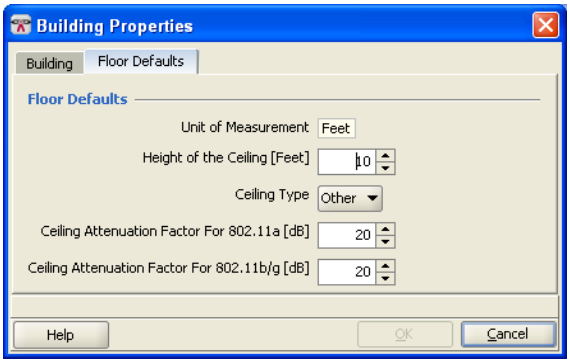
2. The **Site Properties** dialog box prompts you for information about buildings.



3. Select a building and click **Properties.....** In the **Building Properties** dialog, select new settings you want for **Building** and **Floor** under their tabs, then click **OK**.





Modifying Floors in Existing Buildings

To create or modify a floor in a building:

1. Select a building in the **Organizer** panel.

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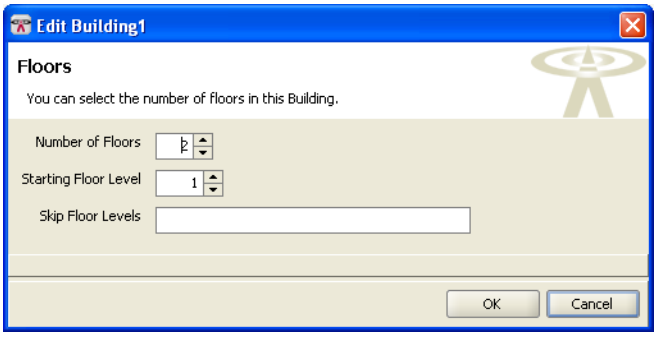
2. If you are editing an existing floor, click on the building name in the **Organizer** panel and select **Edit building** in the **Tasks** panel. Enter floor number, starting floor and skipped floors, then click **OK**



Importing a Drawing of a Floor

You can import a floor plan into *RingMaster* in any of the following file types:

- *AutoCAD* drawing (DWG) — A native binary format used by *AutoCAD*. You can import versions R13, R14, or R2000. Use R2000 if available.
- Drawing Interchange Format (DXF) — An ASCII-based interchange format used for multi-vendor interoperability. You can import versions R12, R13, R14, or R2000. Use R2000 if available.
- Graphics Interchange Format (GIF) (.gif)
- Joint Photographic Experts Group (JPEG) (.jpeg, .jpg)

RingMaster cannot import files in *Visio* format. However, you can export a *Visio* file to a DXF or JPG file, then import that file into *RingMaster*. You can also draw a floor plan in *RingMaster* if you do not have a drawing of a floor in a supported file format.

File Recommendations

For optimal results, use a DWG or DXF drawing. These types of drawings are made of vector graphics line objects that can easily convert into RF obstacles after importing a drawing into *RingMaster*. In addition, drawing objects are usually grouped and organized by layers, enabling display and manipulation of similar objects such as walls, doors, and windows.

Drawings in DXF format sometimes import more easily into *RingMaster*. However, you should obtain copies of drawings in both DWG and DXF formats if possible.

A GIF or JPG file is a raster graphics file (a screenshot or background image), is a bitmap and is not made of vector objects. To add RF obstacle information with these files, you must manually draw obstacles into the image.

For optimal performance, use files that are about 1 MB in size or less. (A DXF file is generally about three times the size of a DWG file for the same drawing.) Reduce file sizes for drawings by pruning unnecessary information from the drawing.

Useful AutoCAD Operations and Naming Conventions

Table 3– 1 and **Table 3– 2** provide helpful *AutoCAD* operating tips and naming conventions as you prepare your floor plans for *RingMaster*.

Table 3– 1. AutoCAD Short Cuts

Operation	Path	Hotkey
Zoom Extension— Arranges all items in the drawing view.		Ctrl+Backspace
Explode— Ungroups all items.	**Format > Explode**	Alt+Shift+E

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Table 3– 1. AutoCAD Short Cuts

Operation	Path	Hotkey
Group— Group items.	Use “Create Group” tool or **Format > Create Group**	
Select all items except locked and frozen items.		Ctrl+A

Operating tips in the table above refer to specific command names in *AutoCAD*. Commands are mentioned in *RingMaster* documentation to help find appropriate commands or options in your CAD application. However, the best source of information about how to use your CAD application is the user documentation for that application.

Table 3– 2. AutoCAD Naming Conventions

AutoCAD Layer Name	Commonly Represent...
glaz	windows
scol	steel columns
p-fixt	bathroom
p-part	bathroom stall
partitions	ext – exterior int – interior

Preparing a Drawing Before Importing

RingMaster has a file cleanup feature that removes unwanted information from an imported drawing. However, the more cleanup work you do before importing, the better your results. In addition, cleaning up files before importing helps reduce file size, which enhances performance when handling the file in *RingMaster*.

Juniper Networks offers a CAD cleanup service to perform these functions. Contact your Juniper Networks account representative for details.

To prepare a drawing before importing it into *RingMaster*:

1. Make sure the scale of the paper space is 1” : 1” (full size). Also, ensure that the scale type is the same as that of the model space.
2. Verify that the origin point (0,0) aligns correctly for all floors.
3. Delete unnecessary workspaces or paper layouts. If a drawing contains multiple paper layouts, delete all but the last one (which cannot be deleted) and delete the contents of that layout.
4. Check for externally referenced files. *RingMaster* requires that drawing files be monolithic. If a floor plan uses externally referenced files, significant portions of the floor plan might be missing, even with all layers unfrozen and visible.

In *AutoCAD*, when you load a drawing file, you may see messages about files not being found. To check for external references, you can select **Insert > Xref Manager**. If you look at layers, externally referenced layers have a common prefix label with a **$** delimiter between their label and their description (for example, **SC03$a-WALL-FULL**). If you can see a layer, it either will be blank or will be a single read-only object.

To include information in externally referenced files, place these files in the same directory as the master file. In *AutoCAD*, you can bind information to the master file by selecting **Insert > Xref Manager**, selecting the file, then clicking **Bind**.

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Adding information from referenced files can increase file size. If information you will need to convert into RF obstacles is in a referenced file but not the master file, try importing the referenced file into *RingMaster*. For information on the location of referenced files in *AutoCAD*, refer to *AutoCAD* documentation.

5. Audit the drawing. An audit finds problems between objects in the file and fixes them automatically. To perform an audit in *AutoCAD*, select **File > Drawing Utilities > Audit**.
6. Check for grouped objects, especially groups that span multiple layers or include an entire drawing. If a grouped object contains objects you will assign differing RF values to, or if some objects do not become RF obstacles, ungroup those objects and delete unneeded objects. If all RF objects in a grouped object have the same RF value, leave the object grouped.

   A grouped object can contain multiple layers and visible and invisible objects. (When you select an object that spans multiple layers, the object is not normally selected when you click on it. Instead, a selection square appears, offset to the side of the object.) If you decide to delete a grouped object, ensure that the object does not contain objects to which you will assign RF values.

7. Make visible, unlock, and unfreeze all layers. Delete unnecessary layers. (Locking a layer keeps the layer visible but prevents changes to that layer. Freezing a layer locks the layer and makes it invisible.) In many cases, information in invisible or frozen layers is not related to objects that are RF obstacles, and so is unnecessary in a floor plan. The information you need to keep is structural information that you assign RF values in *RingMaster*.

   To check the contents of invisible layers to verify that information can be discarded, reverse the frozen/unfrozen status of all layers so only layers normally frozen are visible. In *TurboCAD*, delete unneeded layers. In *AutoCAD*, click and drag all visible objects to select them. Delete these objects.

8. Remove all blocks, line types, and layers that are unused.
   - In TurboCAD:
     - To delete a block, select it on the **Blocks** palette and click **Delete**.
     - A line type is an object. To delete an object, select the object and select **Edit > Clear > Selection**.
   - In AutoCAD:
     - Click-drag to select unwanted objects and delete them.
     - When all unwanted objects are deleted, purge the drawing of all unwanted layers, blocks, and fonts by selecting **File > Drawing Utilities > Purge**. Make sure purge nested items is selected. Click **Purge** until the option is greyed out.

9. Create RF-specific layers and move walls, windows, doors, and other objects that affect RF propagation from other layers into new layers. For example, create a new layer called **RF-ExtWalls** for external walls, and move all external wall objects into that layer. In *RingMaster*, select all objects in a layer and assign the same RF attenuation value to them. Create **RF-IntWalls** for interior walls and **RF-Windows** for windows.

   If walls or windows are shown with multiple parallel lines, delete all but one line. (*RingMaster* can remove unneeded parallel lines during cleanup, depending on how close together lines are.)

   To create a new layer in *TurboCAD* 9, select **Options > Layers**. In *AutoCAD*, select **Format > Layer**.

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To move objects to new RF layers, click-drag to select objects, select **Modify >Properties**, and change objects' layer.

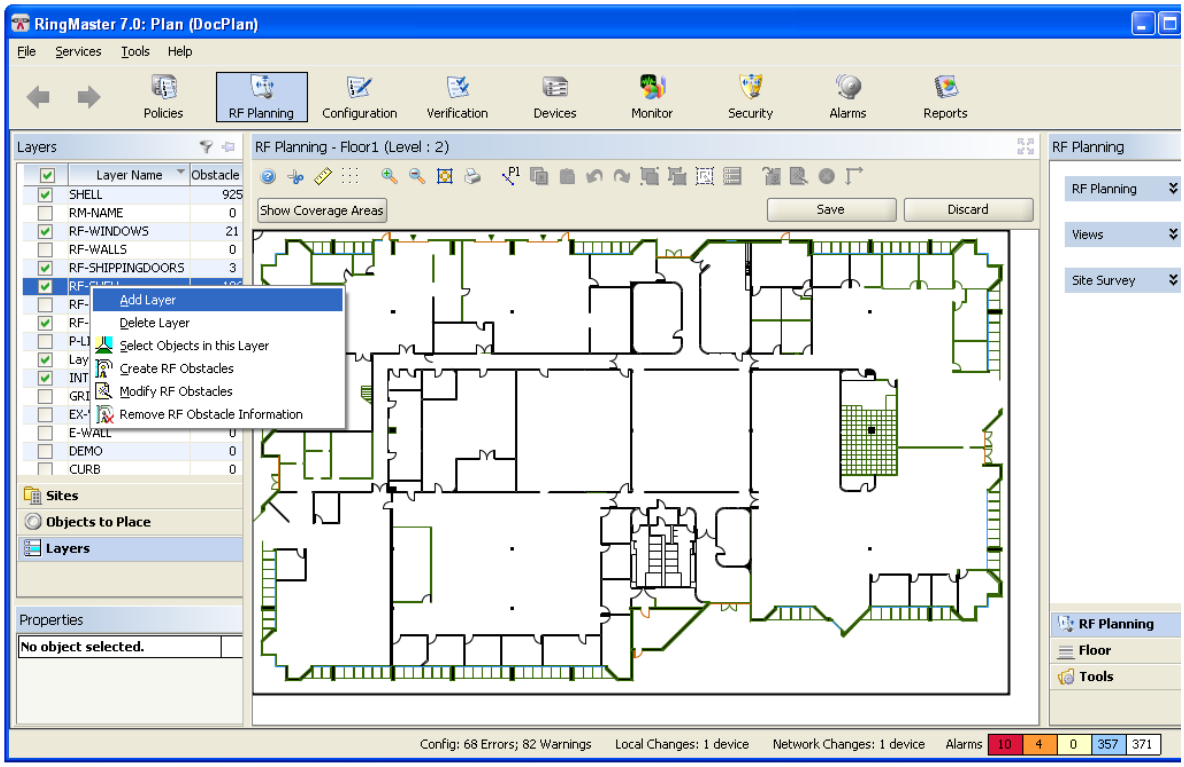
10. Save the drawing in DWG and DXF formats in case one format does not import well. To save the file into a specific format, select **File >Save As** and select the format. Use version R2000 of the format you save as, if available.

Working with Drawings

Editing Drawing Layers

To add a new layer to a drawing, do the following:

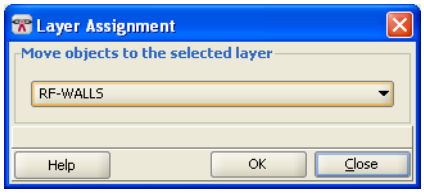
1. Right-click (Macintosh: Control+click) the list of layers in the **Organizer** panel.
2. Select **Add Layer** from the menu that is displayed. *RingMaster* adds the new layer to the list and highlights its name so you can edit it.



3. Edit the name.

To move an object from one drawing layer to another:

1. In the drawing, select the object(s).
2. Click on the toolbar. The **Layer Assignment** dialog box appears.



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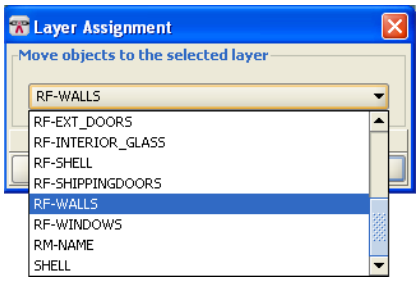
3. Click the down arrow to display the list of layers in the drawing, and select the layer in which you want to move object(s). Click **OK**.



Adjusting the Origin Point

RingMaster uses an origin point in a building to align floors above or below a given floor. When calculating RF coverage, *RingMaster* needs to understand where MP access points on adjacent floors are located so it can take RF from those APs into account when assigning channels. If an imported drawing has an origin point defined, *RingMaster* tries to use that origin point. Otherwise, *RingMaster* places an origin point in the upper left corner of a drawing by default.

You are not required to use the upper left corner of the building as the origin point. You can select an easily identifiable feature on all floors, such as an elevator shaft. Or, to include additional features not on the floor, you can extend the drawing beyond the exterior walls by moving the origin farther up and left.

To adjust an origin point:

1. Display the floor plan in the **Content** panel.
2. Drag and drop (the crosshairs icon) to the new location.

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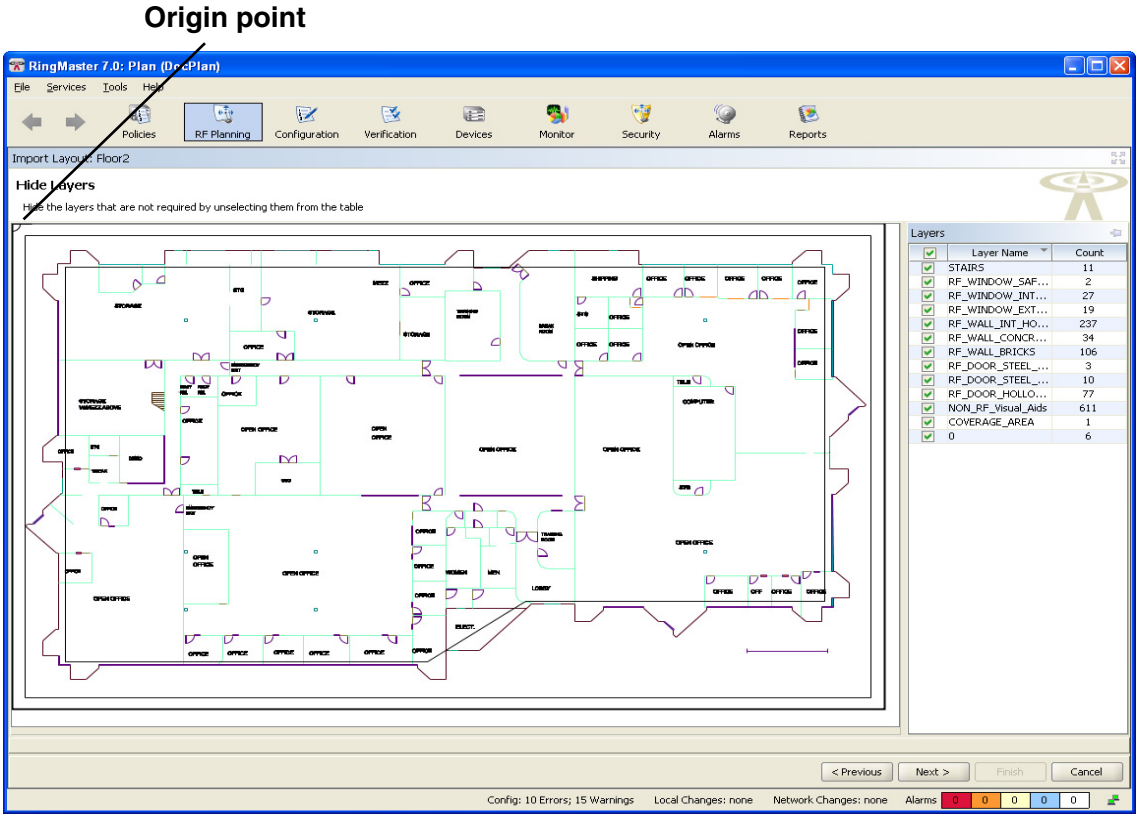
The following graphic shows an example of a floor plan with an origin point in the upper left corner of the drawing.



Cleaning Up a Drawing

RingMaster can simplify an imported CAD drawing by removing unnecessary objects from each layer. Drawing cleanup eliminates unneeded objects, lines, and text.

When cleaning up a drawing:

- Drawing cleanup does not apply to GIF or JPEG drawings.
- Drawing cleanup does not change objects that are grouped.
- If two objects that would normally be cleaned (such as two parallel lines close together) exist on different layers, then neither object is removed.

To clean up a drawing:

1. Display the floor plan in the **Content** panel.

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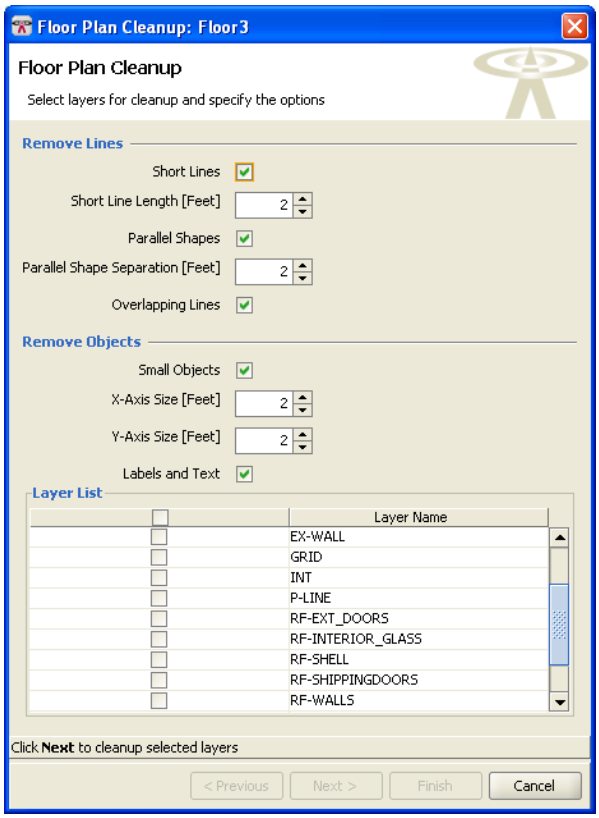
2. In the **Tasks** panel, under **RF Planning**, click **Clean Layout**. The **Floor Plan Cleanup** wizard appears.



3. In the **Remove Lines** and **Remove Objects** group areas of the dialog, select items you do not want *RingMaster* to remove from a drawing during cleanup. *RingMaster* otherwise removes all these items by default.
4. To change the short line length, type or select the new length in the **Short Line Length** field. *RingMaster* removes all lines that are this length or shorter.
5. To change parallel shape separation distance, type or select a new length in the **Parallel Shape Separation** field. *RingMaster* removes parallel shapes this distance or less apart from a shape they parallel. For example, if a wall is drawn as parallel lines, *RingMaster* can remove one of the lines to make the wall a single line.
6. To change the maximum size of objects to be removed, type or select new horizontal and vertical dimensions in the **X-axis** and **Y-axis** boxes. *RingMaster* removes all objects that fit within both specified axes.
7. From the **Layer** list, select layers you want to clean up. You can select individual layers or all layers. *RingMaster* removes specified objects from layers you select. By default, no layers are selected.

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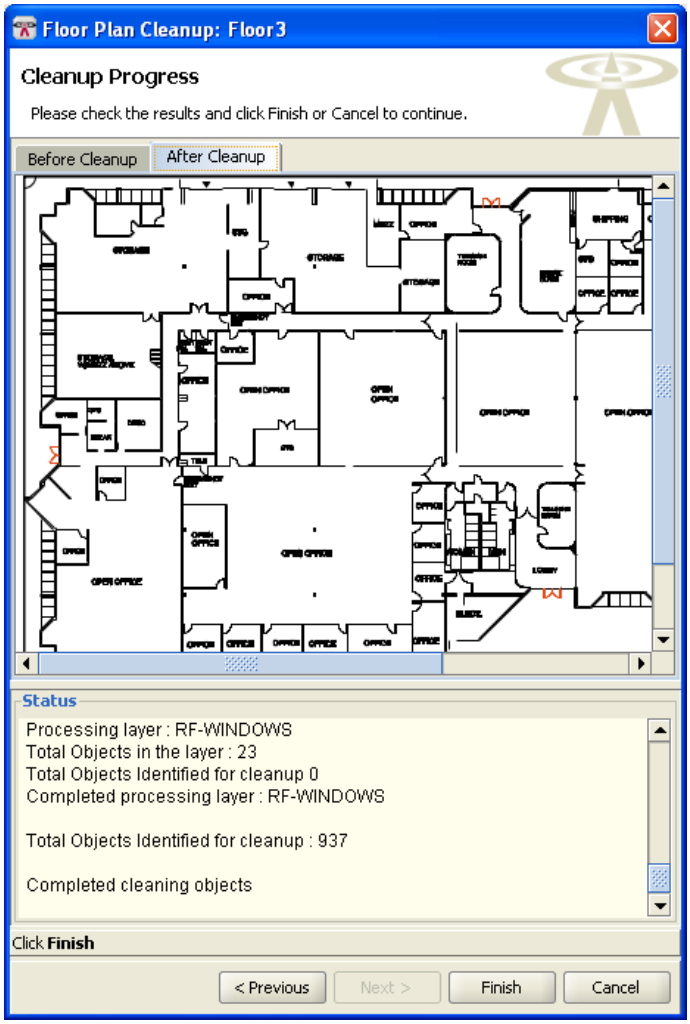
8. Click **Next**. The **Before Cleanup** tab appears. Progress of cleanup is shown in the message area below the floor plan. When cleanup is finished, the **After Cleanup** tab appears. (The example below shows a cleanup in progress.)



9. Click the **After Cleanup** tab. The cleaned up drawing appears.
10. Perform one of the following:
    - Click **Finish** to accept the changes.
    - Click **Previous** to change the cleanup constraints.
    - Click **Cancel** to cancel changes.

Drawing Floor Objects Manually

You can use the **Free Draw** palette to add objects to a floor drawing other than RF obstacles — for example, a conference room table.

Tools for drawing non-RF objects work like the tools for drawing RF objects. To draw a non-RF object, you use the tools in the **Free Draw** group field. To draw RF objects, use the tools in the **RF Obstacle** group field. (See **Drawing RF Obstacles**.)

To draw an object:

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1. Display a floor plan in the **Content** panel.
2. In the **Tasks** panel, click **Tools**.
3. In the **Free Draw** area under **Layout**, click one of the icons and draw the object as described in the following table:

Free Draw Object	Action
(circle)	Diagonally drag the cursor over the area where you want the circle to appear.
(square)	Diagonally drag the cursor over the area where you want the square to appear.
(parallelogram)	1. Click at a vertex, drag the cursor to the next vertex. 2. Click again, drag cursor until the parallelogram takes the shape you want. 3. Click to finish.
(polygon)	1. Click at a vertex, then move the cursor to the next vertex. 2. Repeat until polygon takes the shape you want. For a polygon with n sides, click n-1 additional times at the vertices. For example, to draw a 7-sided polygon, click at 6 vertices. 3. At the last vertex before completing the shape, Right-click (Macintosh: Control+click) to complete the polygon.
(line)	1. Click at the start of the line. 2. Drag the cursor to the end of the line. 3. Click to finish.
(Cursor, under Select)	1. Click to exit free draw mode.

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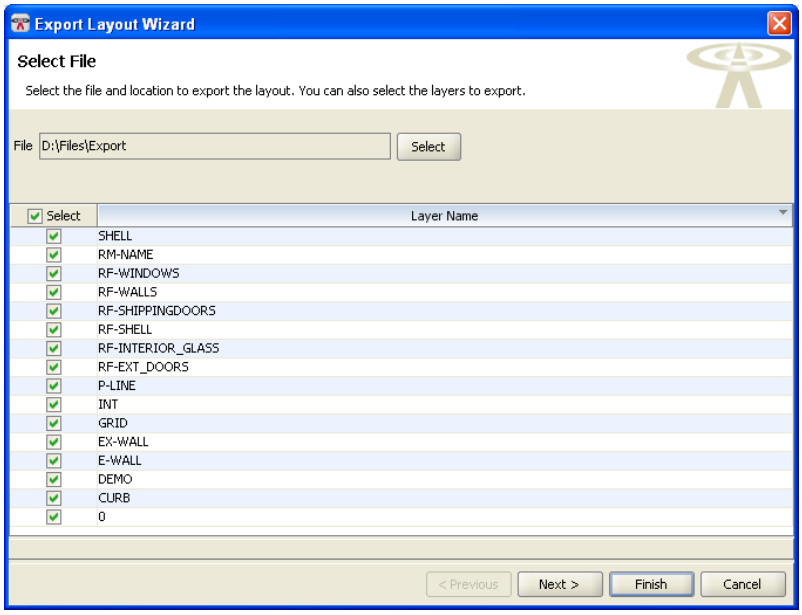
Exporting a Layout

When a floor plan is displayed in the **Content** panel, you can export the layout and select the layers to include by clicking on **Export Layout** in the **Tasks** panel.



You can select layers to export and create a name for the exported file. Click **Finish**.

Creating RF Obstacles Manually

When planning a WLAN, consider how a building layout and physical objects affect signal loss. Walls, windows, and doors absorb RF signals, and various building materials have different attenuation factors. You can model an RF obstacle on your floor plan and assign an obstacle type and attenuation factor, or assign an obstacle type and attenuation factor to objects in a DWG or DXF drawing. *RingMaster* uses these values when calculating coverage for a network.

If you do not have an imported drawing or if you are working with a GIF or JPEG image, you create RF obstacles manually. If you are using an imported CAD drawing, you convert many of the objects in the drawing into RF obstacles. All objects having similar construction material should be placed in one layer. For example, if a drawing file has walls in different layers, and after performing a site-survey these walls are found to be similar in material/construction, put them in one layer. In this way, RF attenuation assignment can be performed in one step.

This section shows how to select and draw objects and convert them into RF obstacles. *RingMaster* preserves layers defined in a CAD drawing.

Table 3– 3 provides some common *AutoCAD* layer terminology.

Table 3– 3. Common AutoCAD Layer Terminology

AutoCAD Layer Name	Commonly Represents...
glaz	windows
scol	steel columns
p-fixt	bathroom
p-part	bathroom stall partitions
ext	exterior

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Table 3– 3. Common AutoCAD Layer Terminology (continued)

AutoCAD Layer Name	Commonly Represents...
int	interior

Specifying RF Characteristics of a Floor

RingMaster uses RF attenuation information for a floor when calculating how many APs are needed and where they should be to provide wireless coverage for the floor. RF attenuation information comes from attenuation values associated with objects on a floor that have been converted into RF obstacles. An RF obstacle is an object with an associated attenuation value.

You can add RF obstacles to a floor plan in the following ways:

- Select objects to be RF obstacles and assign attenuation values. This works for floor plans that are imported from CAD drawings. (See **Converting Objects into RF Obstacles**.)
- Use the graphics tools in *RingMaster* to draw RF obstacles and assign attenuation values to them. This method is available for any floor plan. (See **Drawing RF Obstacles**.)
- Import RF measurements from a site survey. This method requires the *Ekahau Site Survey*™ tool to create a site survey. You can use this method alone or in combination with other methods. (See **Importing RF Obstacle Data from a Site Survey**.)

Recommendations

Consider the following when creating RF obstacles:

- Note if a CAD drawing contains overlapping objects. If you create RF obstacles on objects that are on top of each other, attenuation is increased at that point. (*RingMaster* sums the attenuation factors.)
- Grouping objects is useful if you want one attenuation factor for an area on a floor.

Converting Objects into RF Obstacles

When creating RF obstacles, you can optionally:

- Convert all objects in a layer of a CAD drawing into RF obstacles.
- Convert all objects in an area of the drawing into RF obstacles.
- Convert multiple objects in the drawing into RF obstacles.
- Convert grouped objects in the drawing into RF obstacles.

RingMaster preserves the layers defined in a CAD drawing. You can convert all of the objects in the layer into a specific type of RF obstacle.

To create RF obstacles for all objects in a layer:

1. Click **Layers** in the **Organizer** panel to bring up a list of the layers in a drawing.
2. Right-click (Macintosh: Control+click) the list of layers in the **Organizer** panel.
3. Select **Create RF Obstacles** from the menu that is displayed. The **Create RF Obstacle** dialog box appears.

To create RF obstacles for an area in a drawing:

1. Diagonally drag the cursor over the area to create RF obstacles.
2. Right-click (Macintosh: Control+click), and select Create RF Obstacle. The Create RF Obstacle dialog box appears.

To create RF obstacles for multiple selected objects in a drawing:

1. Click an object on the floor.
2. Press **Shift** while clicking on additional objects.

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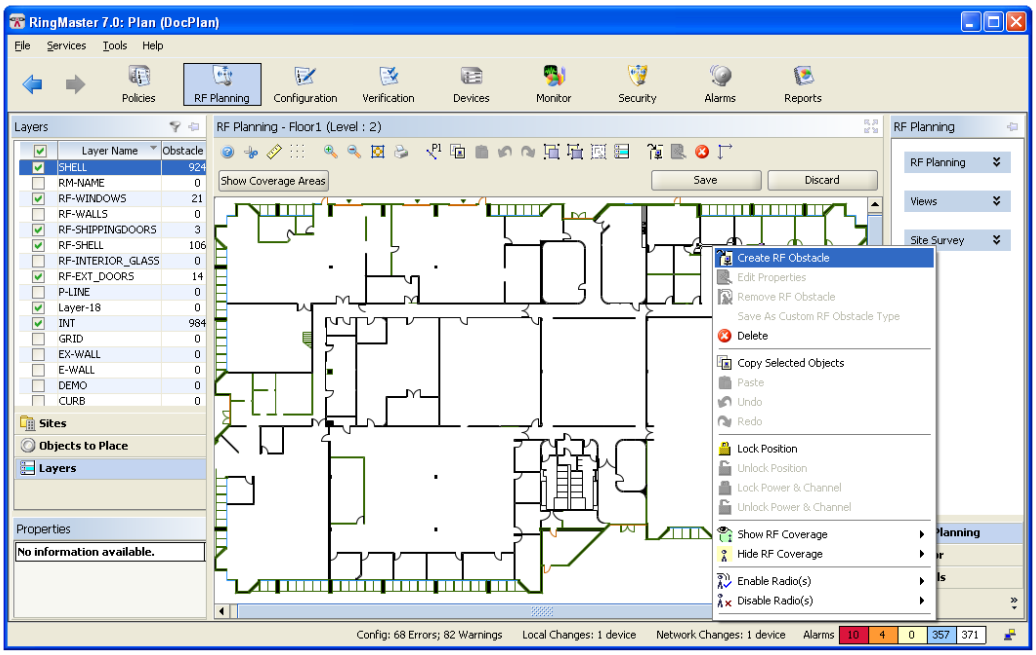
3. Right-click (Macintosh: Control+click), and select Create RF Obstacle. The Create RF Obstacle dialog box appears.

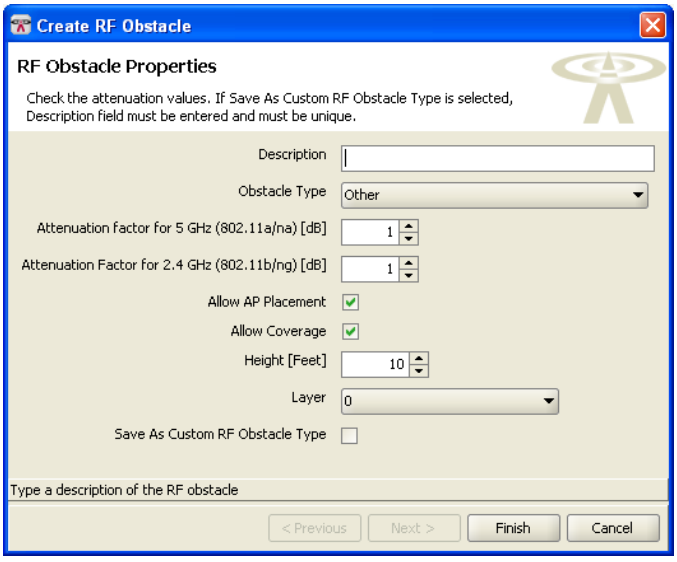
To create RF obstacles by grouping objects:

You can group several objects in a drawing to specify them as one RF obstacle. For example, if a wall consists of several lines, the lines can be grouped. If you subsequently ungroup the objects, the RF obstacle information is removed.

1. Select an object on the floor.
2. Press **Shift** while clicking additional objects.
3. Click the (group objects) icon on the toolbar. Grouped objects now appear as one object.
4. Right-click (Macintosh: Control+click), and select **Create RF Obstacle**.



The **RF Obstacle Properties** dialog box appears.



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1. In the **Description** field, type a description for the obstacle (1 to 60 characters, with no tabs).
2. In the **Obstacle Type** list, select a material for the RF obstacle. Select **Other** if the material is not listed. This allows you to create your own obstacle type.
3. From the **Attenuation Factor** fields, specify attenuation factors for 5 GHz and 2.4 GHz technology (0 to 100 dB). The default is the typical attenuation factor for the material chosen.
4. Select if you want to **Allow AP Placement** by *RingMaster*.
5. Select if you want to **Allow coverage** calculations by *RingMaster*.
6. Use the pull-down menu to select a **Layer** for the object.
7. Set a height in feet.
8. Designate a **Layer**.
9. Select **Save As Custom RF Obstacle Type**.
10. Click **Finish** to save changes and close the dialog box.

- If you created RF obstacles for all objects in a layer, all objects in the layer are converted into separate RF obstacles.
- If you created RF obstacles for an area, all objects in the area are converted into separate RF obstacles.
- If you created RF obstacles for multiple selected objects, all objects you selected are converted into separate RF obstacles.
- If you created RF obstacles for grouped objects, each grouped object is converted into a single RF obstacle.

Drawing RF Obstacles

1. Display a floor plan in the **Content** panel.
2. In the **Tasks** panel, click **Tools**.
3. In the **RF Obstacle** area under **Layout**, click one of the drawing tool icons shown below:

RF Obstacle Object	Action
(circle)	Diagonally drag the cursor over the area where you want the circle to app
(square)	Diagonally drag the cursor over the area where you want the square to ap Treats squares as one solid object when calculating RF attenuation. To dra outline, draw four lines in a square shape — they are treated as four sepa obstacles.
(parallelogram)	1. Click a vertex, and drag the cursor to the next connected vertex. 2. Click again, and drag the cursor until the parallelogram takes the shape you 3. Click to finish.
(polygon)	1. Click a vertex, then move the cursor to the next vertex. 2. Repeat until the polygon takes the shape you want. For a polygon with n sides, click n-1 additional times at the vertic example, to draw a 7-sided polygon, click at 6 vertices. 3. At the last vertex before completing the shape, Right-click (Macintosh: Cont complete the polygon. *RingMaster* supports concave polygons. A concave polygon contains an i angle greater than 180 degrees.
(line)	1. Click at the start of the line. 2. Drag the cursor to the end of the line. 3. Click to finish.
(Cursor)	1. Click to select an item.

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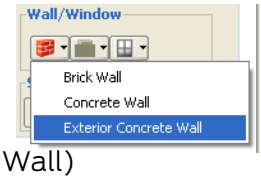
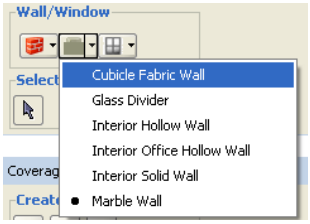
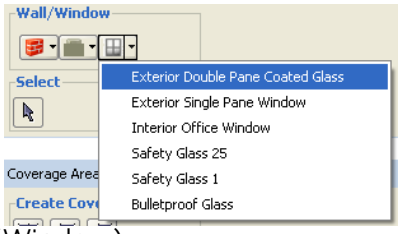
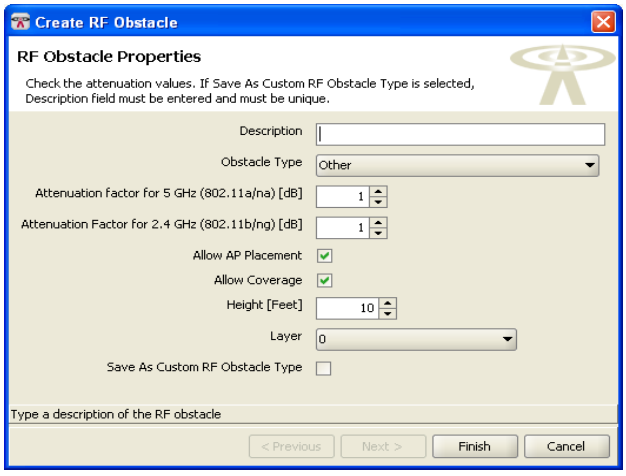
Wall/Window Object	Action
 (Brick/Concrete Wall)	Select brick or concrete wall type and then use cu wall on floor drawing.
 (Interior Wall)	Select interior wall type and then use cursor to dra floor drawing.
 (Window)	2. Select window type and then use cursor to draw v floor drawing.

The **Create RF Obstacle** dialog box appears.



1. Enter a **Description** for this RF obstacle.

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2. From the **Obstacle Type** menu, select an obstacle type.
3. From the **Attenuation Factor** fields, specify attenuation factors for 5 GHz and 2.4 GHz technology (0 to 100 dB). The default is the typical attenuation factor for the material chosen.
4. Select if you want to **Allow AP Placement** by *RingMaster*.
5. Select if you want to **Allow coverage** calculated by *RingMaster*.
6. Select a **Layer** for the object.
7. Select if you want to **Save As Custom RF Obstacle Type**.
8. Click **Finish** to save changes and close the dialog box or **Cancel** to abort.

Importing RF Obstacle Data from a Site Survey

You can import RF measurement data from a site survey that was performed without *RingMaster*. Using a report from *RingMaster*, a map is created for a site for use in an Ekahau site survey. After a survey is completed, measurement data is imported into *RingMaster* and RF obstacles adjusted. In this way, measured information about RF obstacles is incorporated into a plan. This guide contains post-deployment information about optimization on **Displaying an RF Coverage Area**. For pre-deployment information about optimization, refer to “Optimizing a Network Plan” in the *Juniper RingMaster Reference Manual.*

This method of adding RF obstacle data requires the following tools:

- *RingMaster 4.1* or higher
- *Ekahau Site Survey*™ tool (http://www.ekahau.com) and a laptop PC on which to run the tool when you take measurements.
- An “AP on wheels” — a portable AP you can move to different locations on a floor as you take RF measurements with the site survey tool.

To use this method, perform the following tasks:

1. In *RingMaster*, identify major RF obstacles and assign attenuation values to them. You can select any attenuation value. *RingMaster* uses RF measurement data from the site survey to correct attenuation values. (See **Converting Objects into RF Obstacles** and **Drawing RF Obstacless**.)

2. In *RingMaster*, indicate positions for the portable AP. These positions are Line Of Sight (LOS) points. You create LOS points in *RingMaster* or import them from a comma separated values (**.csv**) file. In either case, you must assign a unique MAC address to each LOS. Even though each LOS will use the same portable AP, each position where you use the AP must have a unique MAC address. (See **Adding LOS Points**.) You can place LOS points at places where you will install permanent APs, but this is not a requirement.
3. In *RingMaster*, generate a site survey order. This site survey order includes locations and MAC addresses for LOS points, and also provides a GIF image of the floor. (See **Generating a Site Survey Order**.)
4. In the site survey tool, import the GIF of a floor plan and use the map name specified in the site survey work order.
5. Place the portable AP at the first LOS position and assign the MAC address specified in the work order. Start the site survey tool on the laptop PC and take measurements. (See the Ekahau site survey documentation for specific instructions.)
6. In *RingMaster*, import RF measurements from site survey file. (See **Importing RF Measurements**.)
7. In *RingMaster*, build an attenuation library. This updates the attenuation of RF obstacles already in the plan. In addition, it adds new obstacles detected during the survey. (See **Applying RF Measurements to a Floor Plan**.)
8. In *RingMaster*, define wireless coverage areas. (See **Creating Coverage Areas**.)

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Site Survey Recommendations

This guide does not describe how to use the site survey application. For this information, refer to Ekahau site survey documentation.

When conducting a survey, a following will produce optimal results:

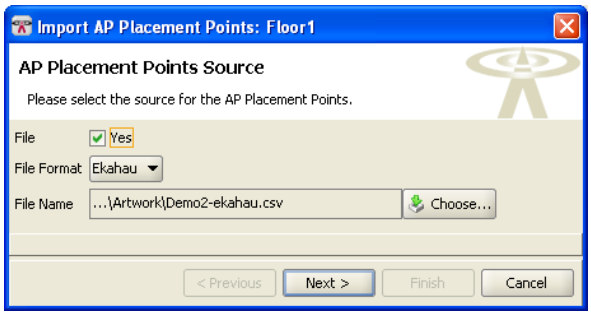
- Verify that the scale of a floor plan is correct before generating a work order. If you use a drawing of a floor that is from another source, make sure the scale of the drawing is correct.
- Use an AP with an omnidirectional antenna, instead of a directional antenna.
- Run the AP at full power in each location.
- Make sure to use a unique MAC addresses at each portable AP location. If you use the same MAC address for multiple locations, RF measurement data will be inaccurate.
- While conducting a survey:
  - Walk slowly and evenly, and click at each turn.
  - Walk around the area you are surveying, completing a 360-degree scan of the area.
  - Avoid placing your body between the AP and the laptop. Your body adds attenuation.

Adding LOS Points

Line Of Sight (LOS) points are locations for a portable AP. You must add LOS points to a floor plan before generating a site survey order. You can add LOS points by importing them from a file or by creating them in *RingMaster*.

To import LOS points from a file:

1. Use the site survey tool or some other means to prepare a **.csv** file containing the MAC address of each LOS point.
2. Display a floor plan in the **Content** panel.
3. In the **Tasks** panel, click **RF Planning**.
4. Under **Site Survey**, click **Import Points**. The **Import AP Placement Points** dialog is displayed.



5. Click **Yes** next to **File**.
6. From the **File Format** list, select **Ekahau**.
7. Click **Choose** to navigate to the **.csv** file that contains LOS points.

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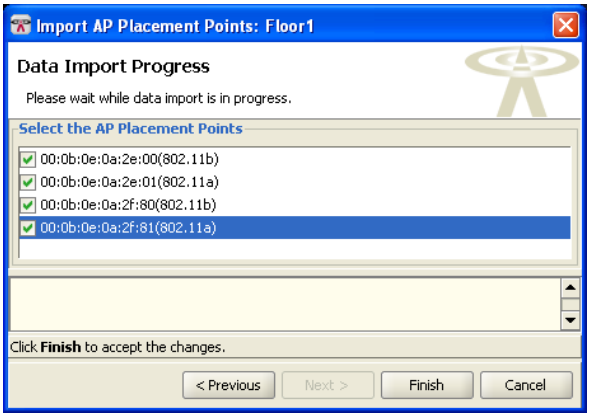
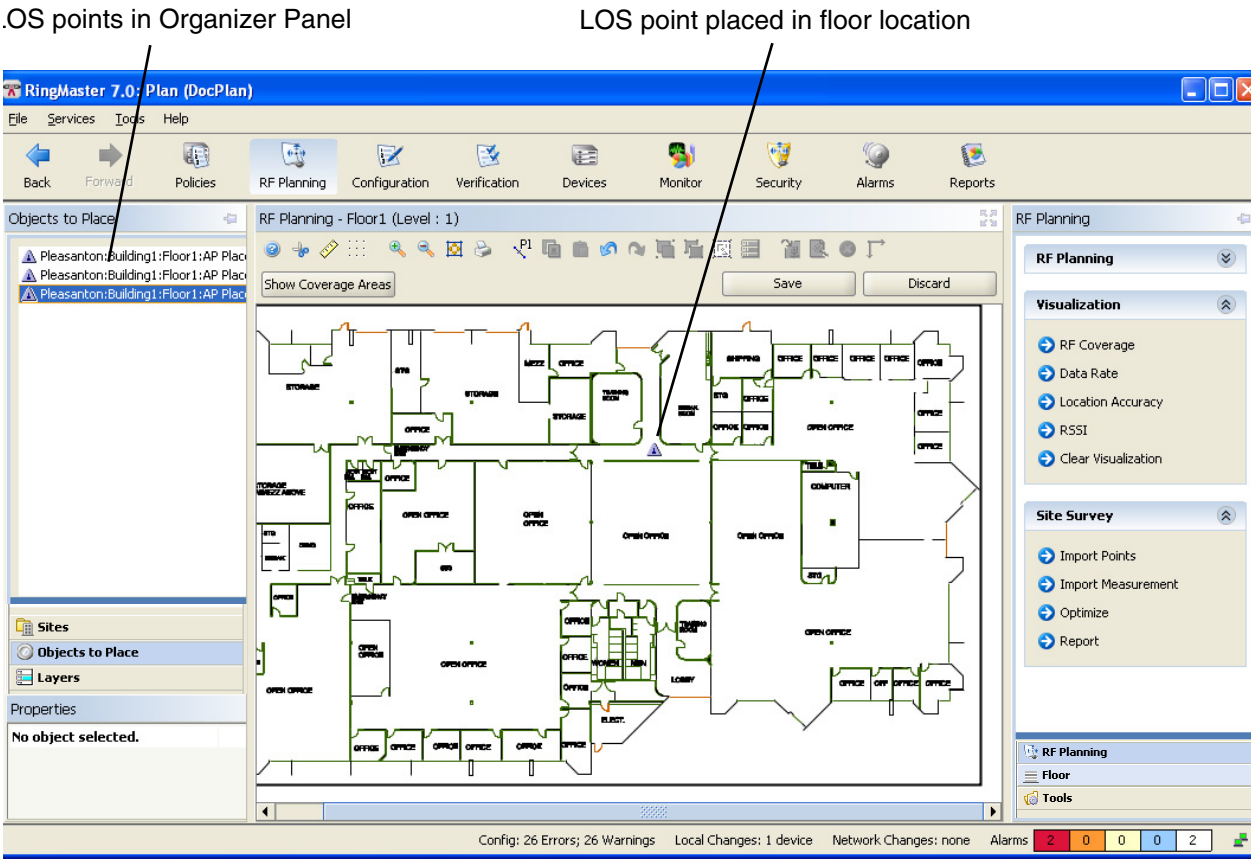
8. Click **Next**. The MAC addresses of LOS points appear.



9. Select the MAC address of each LOS point you want to import.

Click **Finish**.

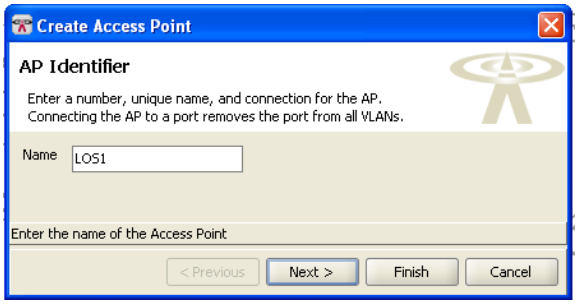
10. Place LOS points on the floor plan. Click **Objects to Place** in the **Organizer** panel to display LOS points for each MAC address you selected. Click on an LOS point to select it, then move the cursor to the floor location and click again to place that LOS point.



When you place an LOS point onto a floor plan, the icon disappears from the **Organizer** panel.

To create LOS points in *RingMaster*:

1. Display a floor plan in the **Content** panel.
2. In the **Tasks** panel, click **Tools**.
3. Under **Site Survey**, click the icon.
4. On the floor plan, click on the location for an LOS. The **Create Access Point** wizard appears.


Create Access Point
AP Identifier
Enter a number, unique name, and connection for the AP.
Connecting the AP to a port removes the port from all VLANs.
Name
LOS1
Enter the name of the Access Point
< Previous
Next >
Finish
Cancel

5. In the **Name** field, type a name for an LOS point and click **Next**.

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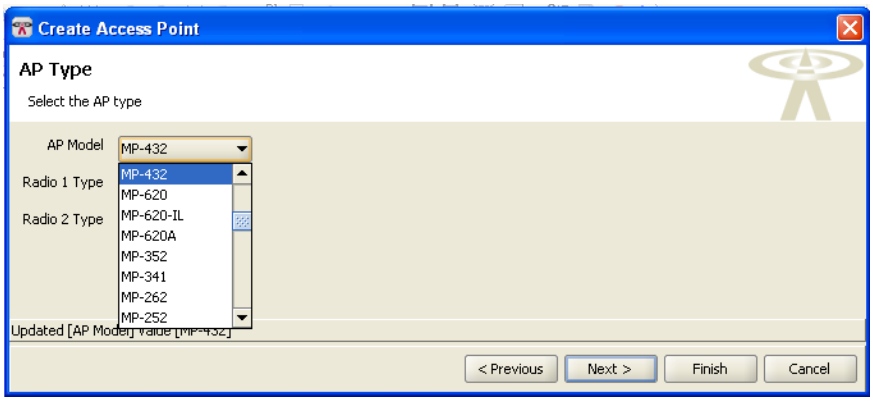
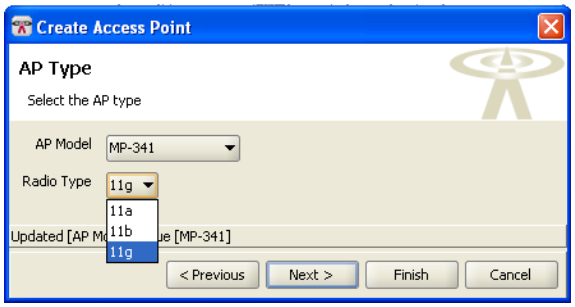
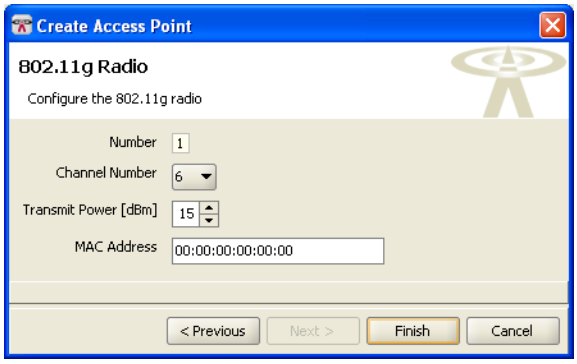
6. From the **AP Model** list, select the type or model of AP you plan to use for the portable AP. If the model is not listed, select **AP (Dual Radio)** for a dual-radio AP or **AP (Single Radio)** for a single-radio AP.



7. In the **Radio Type** list box, select the 802.11 radio type. The radio types available depends on the AP model or type selected.



8. Click **Next**. A radio configuration page appears.



9. In the **Channel Number** listbox, specify a channel number to operate the AP radio.
10. From the **Transmit Power** list, specify the radio transmit power for the AP.

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11. In the **MAC Address** field, type the MAC address to use for this position of the AP.

12. If the selected AP model has more than one radio, configure the other radio.
13. Click **Finish** to save changes and close the wizard. An LOS point icon appears on the floor plan where you clicked to open the **Create AP Placement Point** wizard.

To move an LOS icon, click-and-drag to select the icon and move it to its new location. To temporarily remove an LOS point from a floor without deleting it, click and drag the LOS icon to the **Objects To Place** area of the **Organizer** panel.

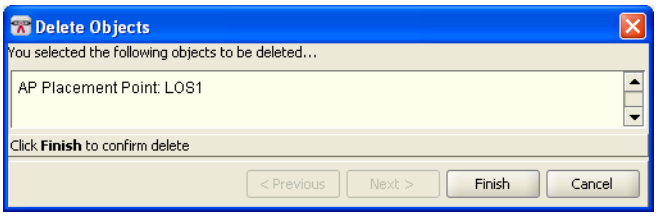
To move the LOS back onto a floor:

1. Click on the LOS in the **Objects To Place** area of the **Organizer** panel.
2. Move the cursor to the floor location where you want to place the LOS.
3. Click to place the LOS.

You cannot delete an LOS directly from the **Objects To Place** tab. To delete an LOS point, place it somewhere on the floor, then delete it. (See instructions below.)

To permanently remove an LOS icon from a floor:

1. Right-click (Macintosh: Control+click) on the LOS icon.
2. Select **Delete**. The **Delete Objects** wizard appears.



Click **Finish** to confirm deletion.

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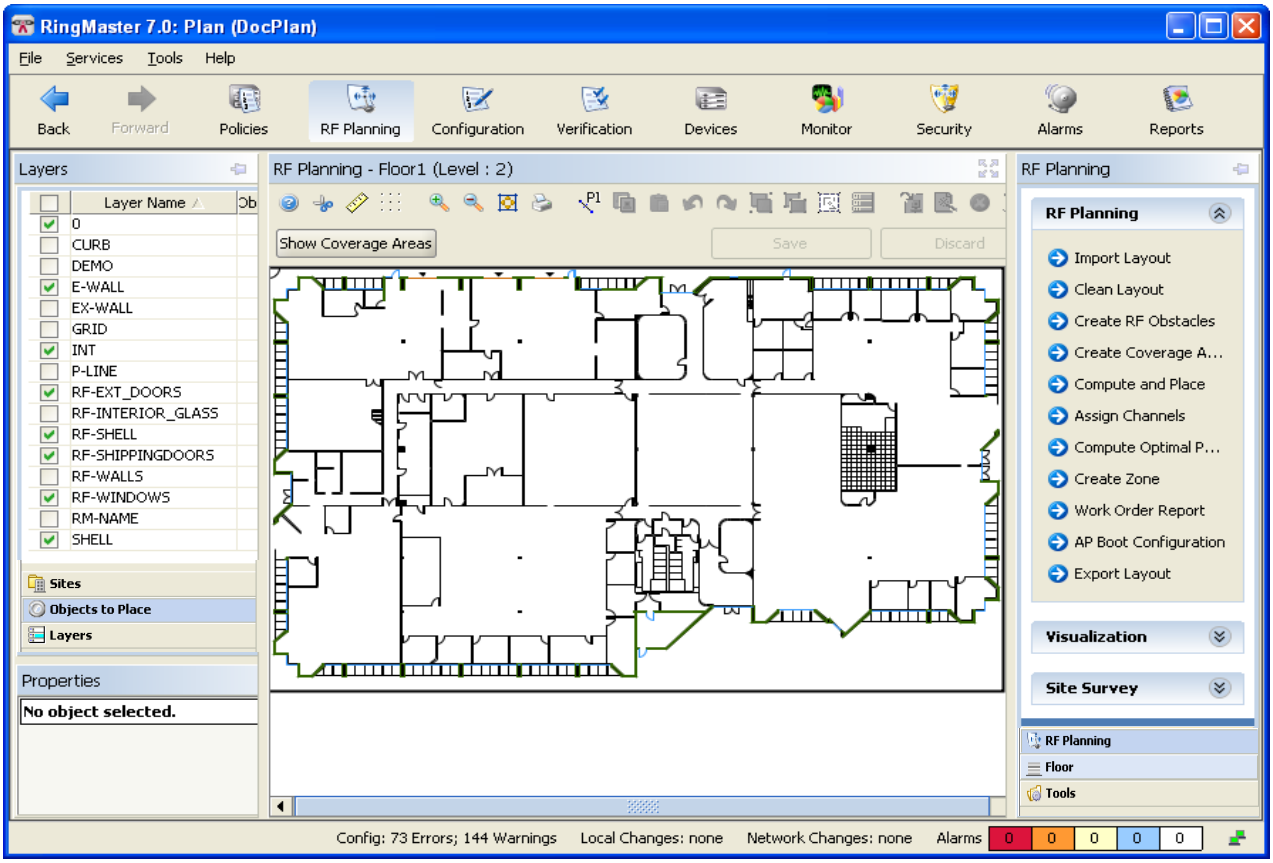
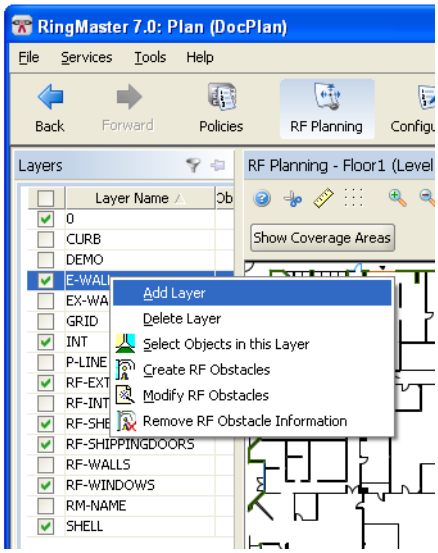
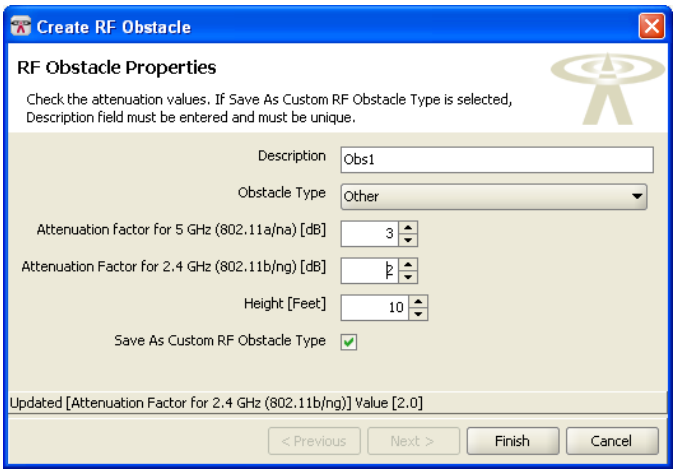
Creating RF Obstacles For Objects in a Layer

1. Click **Layers** in the **Organizer** panel to bring up a list of the layers in the drawing.



2. Right-click (Macintosh: Control+click) one of the layers in the **Organizer** panel. Select **Create RF Obstacles**. A dialog appears where you set properties for an obstacle type.




Create RF Obstacle
RF Obstacle Properties
Check the attenuation values. If Save As Custom RF Obstacle Type is selected, Description field must be entered and must be unique.
Description
Obs1
Obstacle Type
Other
Attenuation factor for 5 GHz (802.11a/na) [dB]
3
Attenuation Factor for 2.4 GHz (802.11b/ng) [dB]
Height [Feet]
10
Save As Custom RF Obstacle Type
Updated [Attenuation Factor for 2.4 GHz (802.11b/ng)] Value [2.0]
< Previous
Next >
Finish
Cancel

3. Define an RF obstacle.

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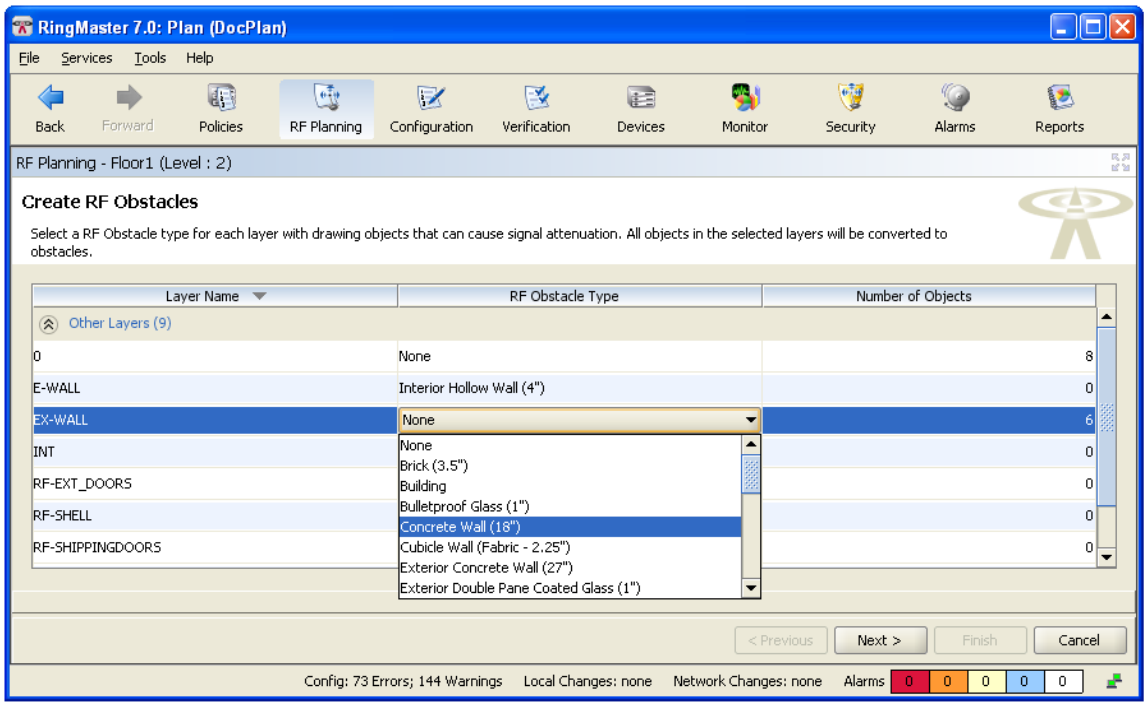
4. Click **Finish**.

If you select **Create RF Obstacles** under **RF Planing** in the **Tasks** panel. The **Create RF Obstacles** dialog box appears. This allows you to make selections to describe all the layer types in your layout. Make needed selections, then click **Next**


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security Alarms Reports
RF Planning - Floor1 (Level : 2)
Create RF Obstacles
Select a RF Obstacle type for each layer with drawing objects that can cause signal attenuation. All objects in the selected layers will be converted to obstacles.
Layer Name
RF Obstacle Type
Number of Objects
Other Layers (9)
0 None 8
E-WALL Interior Hollow Wall (4") 0
EX-WALL None 6
INT 0
RF-EXT_DOORS 0
RF-SHELL 0
RF-SHIPPINGDOORS 0
None
Brick (3.5")
Building
Bulletproof Glass (1")
Concrete Wall (18")
Cubicle Wall (Fabric - 2.25")
Exterior Concrete Wall (27")
Exterior Double Pane Coated Glass (1")
< Previous
Next >
Finish
Cancel
Config: 73 Errors; 144 Warnings
Local Changes: none
Network Changes: none
Alarms 0 0 0 0 0

RingMaster presents a screen that allows you to continue planning in a number of ways. Make a selection to continue, or select **Finish**.

RF Obstacle Library

RingMaster creates an **RF Obstacle Library** and for mapping objects as defined RF obstacle types. You can see this library by selecting the Main window menu **Tools -> RF Obstacle Library**. This

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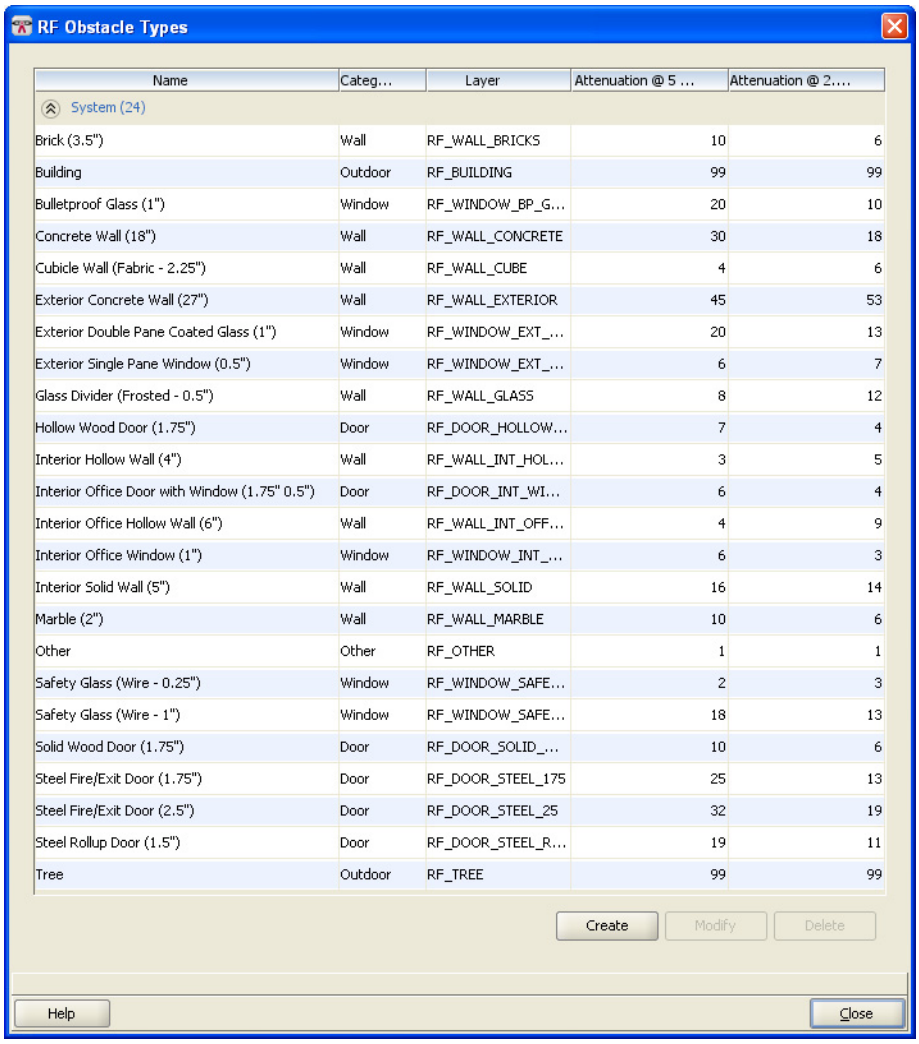
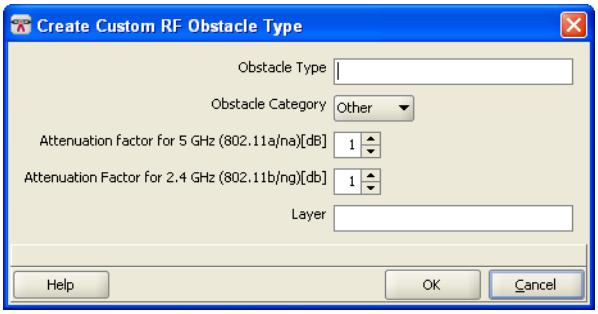
library works across plans, and is useful for defining frequently used obstacles not defined by default. An example of obstacles in this library is shown below.


RF Obstacle Types
Name
Categ...
Layer
Attenuation @ 5 ...
Attenuation @ 2....
System (24)
Brick (3.5") Wall RF_WALL_BRICKS 10 6
Building Outdoor RF_BUILDING 99 99
Bulletproof Glass (1") Window RF_WINDOW_BP_G... 20 10
Concrete Wall (18") Wall RF_WALL_CONCRETE 30 18
Cubicle Wall (Fabric - 2.25") Wall RF_WALL_CUBE 4 6
Exterior Concrete Wall (27") Wall RF_WALL_EXTERIOR 45 53
Exterior Double Pane Coated Glass (1") Window RF_WINDOW_EXT_... 20 13
Exterior Single Pane Window (0.5") Window RF_WINDOW_EXT_... 6 7
Glass Divider (Frosted - 0.5") Wall RF_WALL_GLASS 8 12
Hollow Wood Door (1.75") Door RF_DOOR_HOLLOW... 7 4
Interior Hollow Wall (4") Wall RF_WALL_INT_HOL... 3 5
Interior Office Door with Window (1.75" 0.5") Door RF_DOOR_INT_WI... 6 4
Interior Office Hollow Wall (6") Wall RF_WALL_INT_OFF... 4 9
Interior Office Window (1") Window RF_WINDOW_INT_... 6 3
Interior Solid Wall (5") Wall RF_WALL_SOLID 16 14
Marble (2") Wall RF_WALL_MARBLE 10 6
Other Other RF_OTHER 1 1
Safety Glass (Wire - 0.25") Window RF_WINDOW_SAFE... 2 3
Safety Glass (Wire - 1") Window RF_WINDOW_SAFE... 18 13
Solid Wood Door (1.75") Door RF_DOOR_SOLID_... 10 6
Steel Fire/Exit Door (1.75") Door RF_DOOR_STEEL_175 25 13
Steel Fire/Exit Door (2.5") Door RF_DOOR_STEEL_25 32 19
Steel Rollup Door (1.5") Door RF_DOOR_STEEL_R... 19 11
Tree Outdoor RF_TREE 99 99
Create
Modify
Delete
Help
Close

You can create your own Custom RF Obstacles types by clicking **Create** on the dialog above. If a new layout is imported and has a layer that matches it, then this Obstacle Type will be used for objects on that layer.



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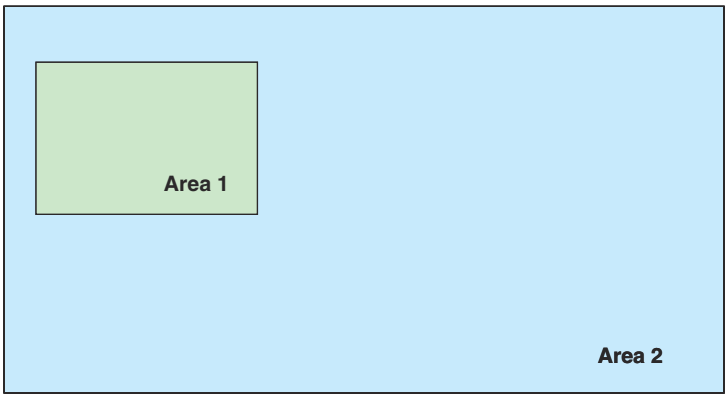
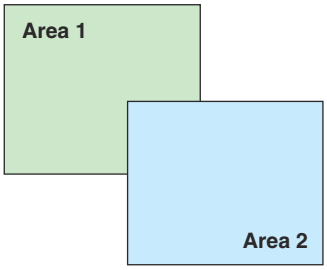
Shared Coverage Areas

RingMaster supports sharing of coverage areas if one area is completely within a larger area. For example, you may want to provide 802.11a and 802.11b coverage in a conference room that is part of a larger coverage area where you are providing 802.11a coverage only. (Coverage areas that partially overlap are not supported.) APs are shared only in the overlapped area.

The figure below shows an example of shared coverage areas:



Coverage areas shown below cannot share coverage and are not supported by *RingMaster*. (However, separate, non-shared coverage areas can overlap.)

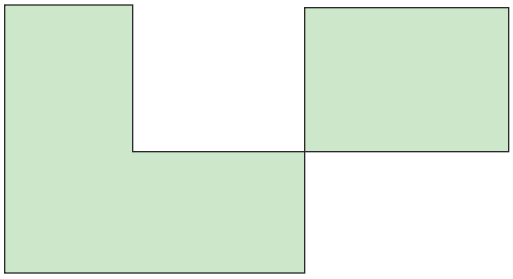


Keep the following in mind when planning shared coverage areas:

- Two coverage areas using the same wireless technology cannot be shared.
- A coverage area using 802.11b and a coverage area using 802.11g cannot be shared.
- APs placed in shared areas must be configured as dual-radio models.

Drawing a Coverage Area

RingMaster supports concave polygons, which have an internal angle greater than 180 degrees. When drawing a polygon, make sure that two sides of the polygon do not intersect each other, as shown below. Also make sure start and end points and the vertices are not too close.



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If you are using a complex concave polygon as a coverage area, computation of APs might take longer than computation for an area with a less complicated shape. When drawing a coverage area, make sure it extends just short of external walls. If a coverage area includes external walls, *RingMaster* accounts for the external walls when computing the number of APs required for a coverage area. This might lead to an inaccurate AP count.

To draw coverage areas:

1. Display a floor plan in the **Content** panel.
2. In the **Tasks** panel, click **Tools**.
3. In the **Create** area under **Coverage Area**, click an icon shown in the table below and draw that type of object.

Object	Action
(square)	Diagonally drag the cursor over an area where you want a square to appear.
(parallelogram)	1. Click at a vertex, and drag the cursor to the next vertex. 2. Click again, and drag until a parallelogram has the shape you want. 3. Click to finish.
(polygon)	1. Click at a vertex, then move the cursor to the next vertex. 2. Repeat until the polygon takes the shape you want. For a polygon with n sides, click n-1 additional times at the vertices. For example, to draw a 7-sided polygon, click at 6 vertices. 3. At the last vertex before completing the shape, Right-click (Macintosh: Control+click) to complete the polygon.

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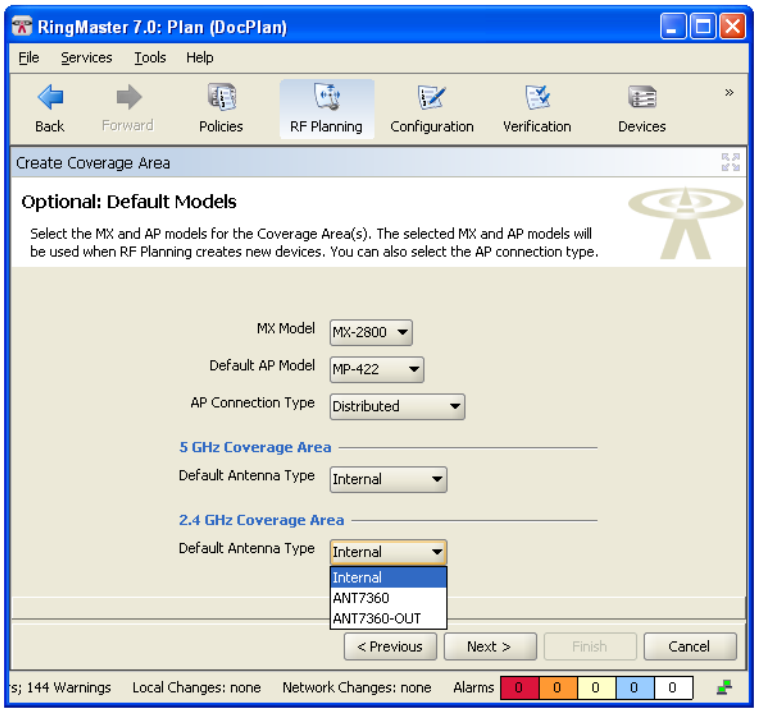
Specifying Default Models for a Coverage Area

1. Click **Default Models**. The **Optional: Default Models** dialog appears.



You can specify MX or AP models for *RingMaster* to use when calculating devices to include in a coverage area.

1. To change MX model, select a model from the **MX Model** list.
2. To change default AP model, select the model from the **Default AP Model** list.

---

3. To change AP (AP) connection type, select a type from the **AP Connection Type** list:
   - **Distributed** — APs can be indirectly attached through intermediate Layer 2 or Layer 3 devices.
   - **Distributed (Auto)** — APs can be indirectly attached through intermediate Layer 2 or Layer 3 devices. APs receive a configuration automatically using a profile that assigns a Distributed AP number and name to the AP from among the unused valid AP numbers available on the switch. The profile also configures the AP with the AP and radio parameter settings in the profile. See “Local Switching” in the publication *RingMaster 7.4 Configuration Guide* for information on creating a profile.

---

4. Select 5 GHz and 2.4 GHz default antenna types from their pull-down menus.
5. Click **finish**.

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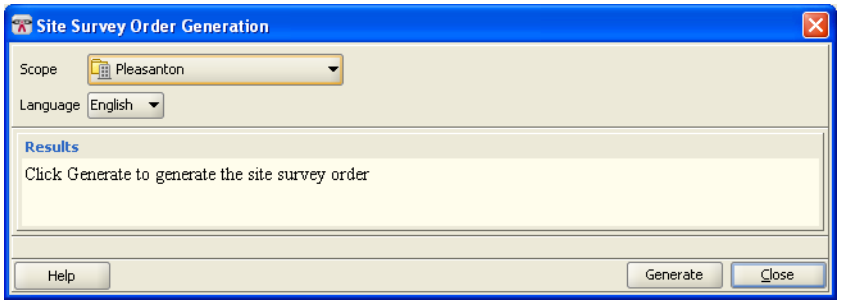
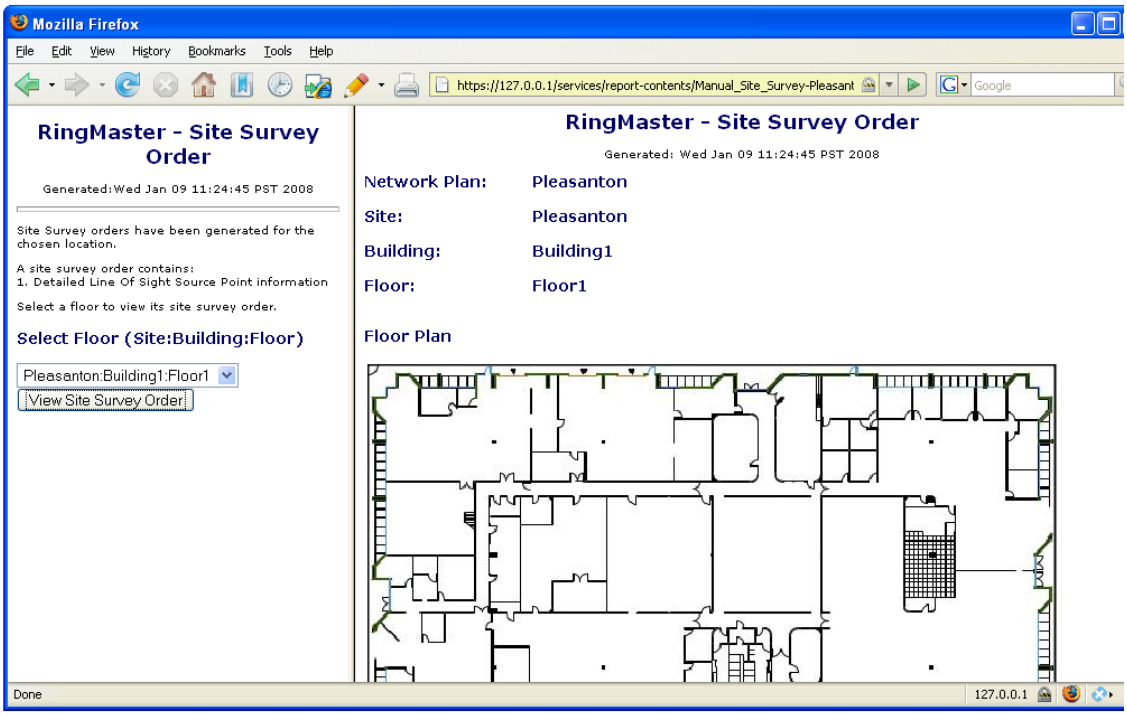
Generating a Site Survey Order

1. Display the floor plan in the **Content** panel.
2. In the **Tasks** panel, click **RF Planning**.
3. Under **Site Survey**, click **Report**. The **Site Survey Order Generation** dialog is displayed.



4. Select the scope for a site survey order. You can specify a Network Plan, an individual site, an individual building, or an individual floor.
5. Select the language for the site survey order:
   - English
   - German
6. Click **Generate**. *RingMaster* generates a site survey order. When the order is complete, a hyperlink becomes available.
7. To view a site survey order, click its link. A browser window opens.

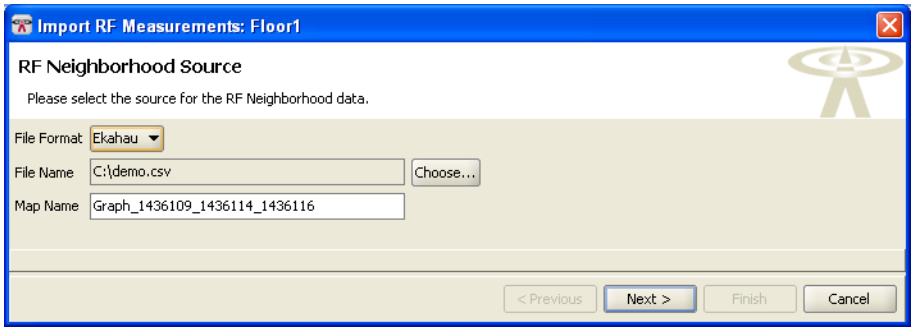

Mozilla Firefox
File Edit View History Bookmarks Tools Help
https://127.0.0.1/services/report-contents/Manual_Site_Survey-Pleasant
RingMaster - Site Survey Order
Generated:Wed Jan 09 11:24:45 PST 2008
Site Survey orders have been generated for the chosen location.
A site survey order contains:
1. Detailed Line Of Sight Source Point information
Select a floor to view its site survey order.
Select Floor (Site:Building:Floor)
Pleasanton:Building1:Floor1
View Site Survey Order
RingMaster - Site Survey Order
Generated: Wed Jan 09 11:24:45 PST 2008
Network Plan: Pleasanton
Site: Pleasanton
Building: Building1
Floor: Floor1
Floor Plan
Done
127.0.0.1

8. Select a floor for which you wish to display LOS point information. Scroll down to view the MAC address assignments for LOS points. Use the instructions in the *Ekahau Site Survey* **Initial Setup** section of the work order to set up the survey.

When you import a floor map into the site survey tool, make sure you use the map name specified in the work order. The site survey data does not appear when you import RF measurements into *RingMaster* if the map name is incorrect.

Importing RF Measurements

1. Display the floor plan in the **Content** panel.
2. In the **Tasks** panel, click **RF Planning**.
3. Under **Site Survey**, click **Import Measurement**. The **Import RF Measurements** wizard is displayed.



4. Select **Yes** next to **File**.
5. In the format listbox, select **Ekahau**.
6. Click **Choose** to navigate to the **.csv** file containing RF measurement data.
7. In the **Map Name** field, specify a map name.

8. Click **Next**. Import progress is displayed. When the import is completed, check the **Total valid RF measurements found** line in the progress messages.
   - If the number is greater than **0**, *RingMaster* successfully imported measurements.
   - If the number is **0**, no measurements were imported. Try the import again and verify that the map name is correct.

Applying RF Measurements to a Floor Plan

1. Under **Site Survey** in the **Tasks** panel, click **Optimize**.

   A wizard appears, listing the progress of the request.

   - The **Total number of RF measurements that did not intersect any object** — Line lists the number of measurements that did not experience attenuation due to an RF obstacle in the path between them. If measurements came from a site survey file, they are measurements between the portable AP (LOS point) and the PC running the site survey tool. If measurements came from AP radios in a network, they are measurements between AP radios.
   - The **Total number of objects that will be corrected** — Line indicates the number of measurements that experienced attenuation. For existing RF objects, *RingMaster* corrects attenuation to match the results. If a floor plan does not have an RF obstacle where the attenuation library indicates one exists, *RingMaster* creates an RF obstacle.

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For RF obstacles created by RingMaster, the description is auto-generated and the obstacle type is Other. You can edit values by selecting an obstacle, clicking the Edit properties icon to open the Modify RF Obstacle wizard, and modify values. Click OK to close the wizard and save changes. (The wizard is the same whether it is labeled Create or Modify.)

Click **Finish**.

Planning RF Coverage

RingMaster RF Planning allows users to plan the wireless network prior to deployment and optimize the network after the original deployment. A good RF plan provides tools that assist with managing the network and allows access to RF visualization. A new user can easily start and complete an RF plan with minimal mistakes and with a clear understanding of the tasks required to complete the plan.

Planning RF Coverage in Buildings

Planning RF coverage depends on whether planning is for either widest coverage or capacity. One group of users may be mobile, with high throughput performance requirements, while another group of users may be stationary and require lower throughput.

Adding Wiring Closets

A wiring closet is a room containing networking devices, such as hubs or switches. If you have an existing wiring closet, you can draw it on a floor layout. If you have previously installed MXs and defined them in *RingMaster*, you can place them in the wiring closet and specify them as switches to be used when *RingMaster* calculates how many APs are required.

If you do not have any MXs placed in a wiring closet, *RingMaster* automatically creates and configures the MXs needed. Each floor plan must have at least one wiring closet if the floor uses APs directly connected to their MXs. However, a floor is not required to have a wiring closet if APs are indirectly attached through a network. In this case, if you do not create a wiring closet, *RingMaster* assumes the MX managing distributed APs is located in a wiring closet on another floor in the building.

A wiring closet is a good location for MXs. You must add at least one wiring closet location to a floor plan. Consider whether you are installing direct APs (access points directly connected to the MX) will be connected to the MX with UTP Cat 5 cabling. Distances between APs and MXs in a wiring closet can not exceed 100 meters (330 feet).

To add a wiring closet:

1. Display the floor plan in the **Content** panel.
2. In the **Tasks** panel, click **Tools** (located low in the right hand corner of the main window).

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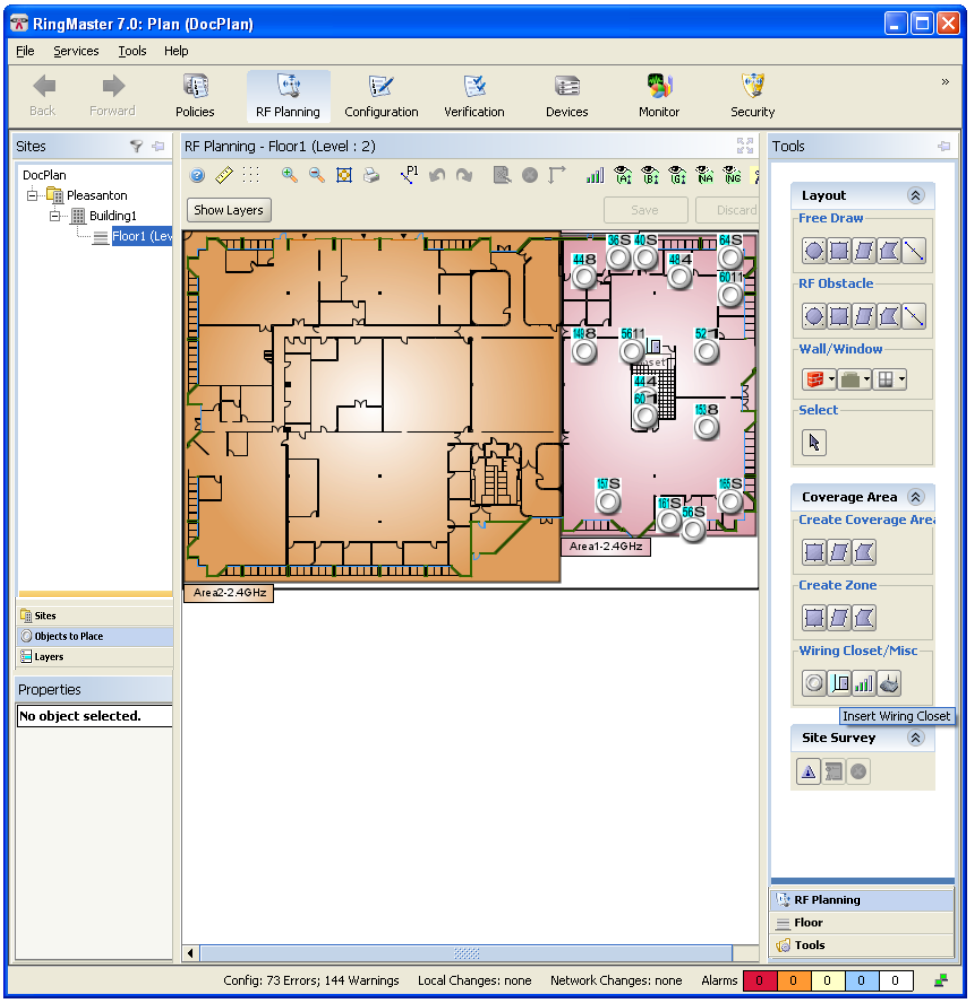
3. In the **Coverage Area > Wiring Closer/Misc** area under Coverage Area, click **Insert Wiring Closet** icon.



Planning with the LA-200E Location Appliance

With the acquisition of Newbury Networks, the LA-200E is now a premier product for Juniper Networks. The LA-200E is a graphical console that provides real time visibility into the activity and status of 802.11 wireless devices. The LA-200 also provides layered views to display devices, associations, device coverage, alerts and more. After adding the LA-200E to your network plan, you can plan, manage, and configure RFID listening APs from a central server. Integrating the LA-200E with RingMaster allows you to manage an LA-200E using network management software.

The integration of the LA-200E into RingMaster is supported by software version 6.4.1 or higher on the LA-200E.

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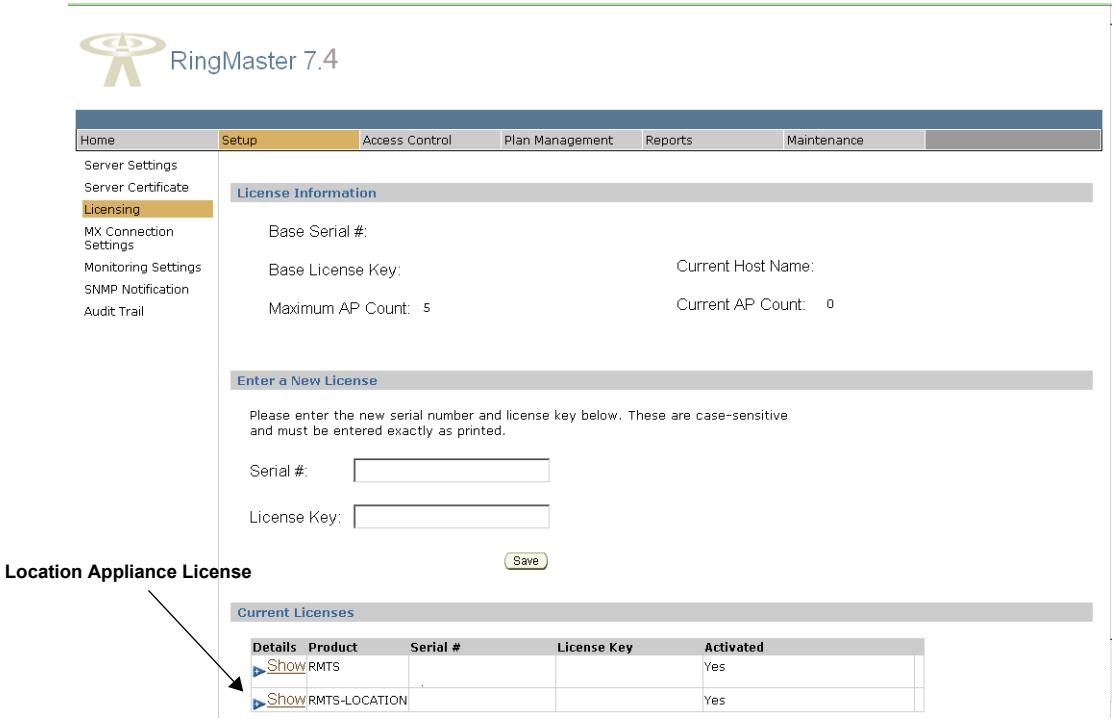
Adding an LA-200E to RingMaster

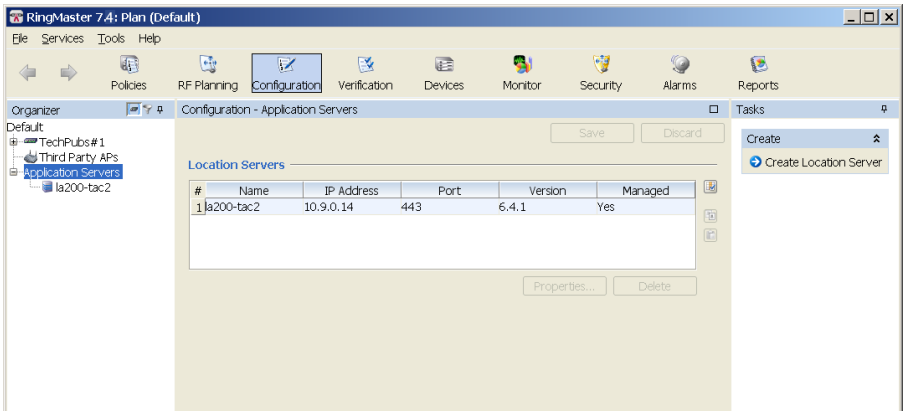
To add an LA-200E to RingMaster, you must install an LA-200E in your wiring closet or have it located somewhere in your network. After installation, you need the following information to add the LA-200E to RingMaster:

- IP Address
- User Name
- Password

You also need a Location Appliance license in order to activate the feature in RingMaster. After installing the license, the Create Location Server task is available in the RingMaster interface.



RingMaster 7.4 with an activated Location Appliance license.



To add an LA-200E to RingMaster, follow these steps:

1. Open RingMaster and click **Configuration** from the menu bar.

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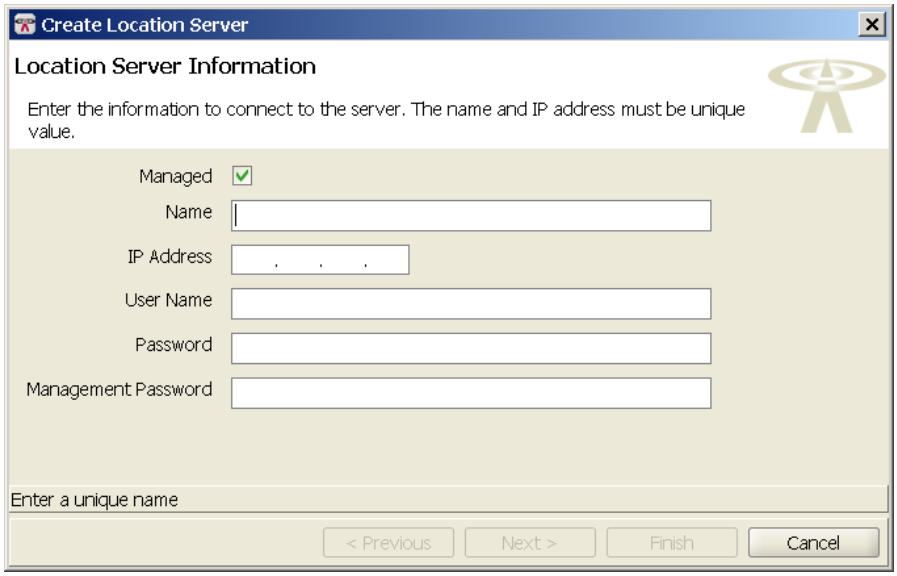
2. From the **Organizer** panel, select **Application Servers**.
3. From the **Task** list, select **Create Location Server** and the associated wizard opens.



4. Select **Managed** to allow RingMaster to manage the location appliance.
5. In the **Name** field, enter the name of the LA-200E.
6. Enter the IP address.
7. Enter the User Name.
8. Enter the Password.
9. If there is a management password, enter the password in the **Management Password** field.
10. Click **Next**. RingMaster connects to the LA-200E and establishes a connection.
11. Click **Finish** to complete the configuration.

The LA-200E now appears in the **Organizer** panel under **Application Servers**.

To review LA-200E settings, highlight the Location Appliance in the list and click **Properties**. You can then change any of the original settings for the server.

Available Tasks for All Managed LA-200E Location Appliances

There is a list of available tasks for all location appliances managed by RingMaster. You can select any of the following tasks:

- Create Location Server
- Setup Synchronization Parameters
- Edit a Location Server
- Configure a Snoop Filter
- Configure SNMP Settings

From the **Other** List, you can select from the following tasks:

- Platform Management
- Appliance Logs
- Backup and Restore
- Configuration
- Factory Reset
- Schedule Reboot
- System Update
- User Management

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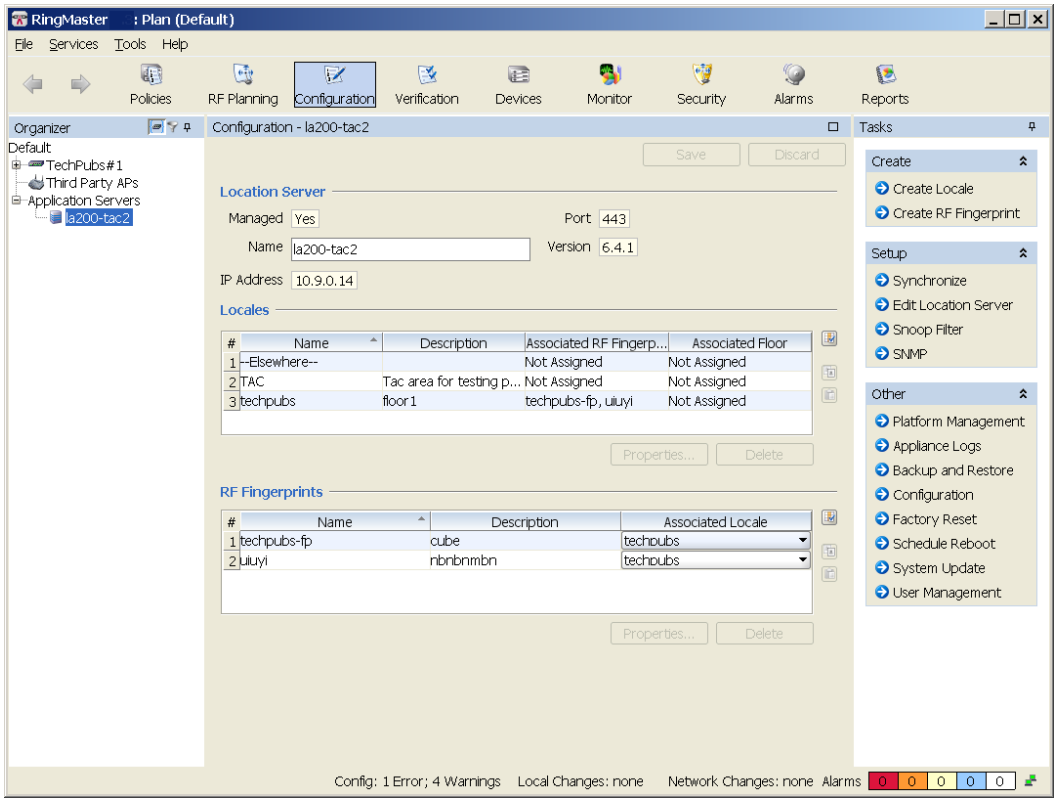
Selecting any of the **Other** tasks opens the corresponding software feature on the location appliance. For more information on using these features, refer to the *Juniper Networks LA-200E User's Guide*.

Available Location Appliance Tasks

If the location appliance already has a configuration, the details are displayed when you select the LA-200E in the Organizer panel.



After it is selected, the following information is displayed:

- Location Server
- Managed
- Name
- Port
- Version
- IP Address
- Locales
- Name
- Description
- Associated Fingerprints
- Associated Floor
- RF Fingerprints
- Name
- Description
- Associated Locale

In the **Tasks** panel, you can select from a list of available tasks. Under **Create**, you can select

- Create Locale
- Create RF Fingerprint

Under **Setup**, you can select

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- Synchronize
- Edit Location Server
- Snoop Filter
- SNMP

Under **Other**, you can select

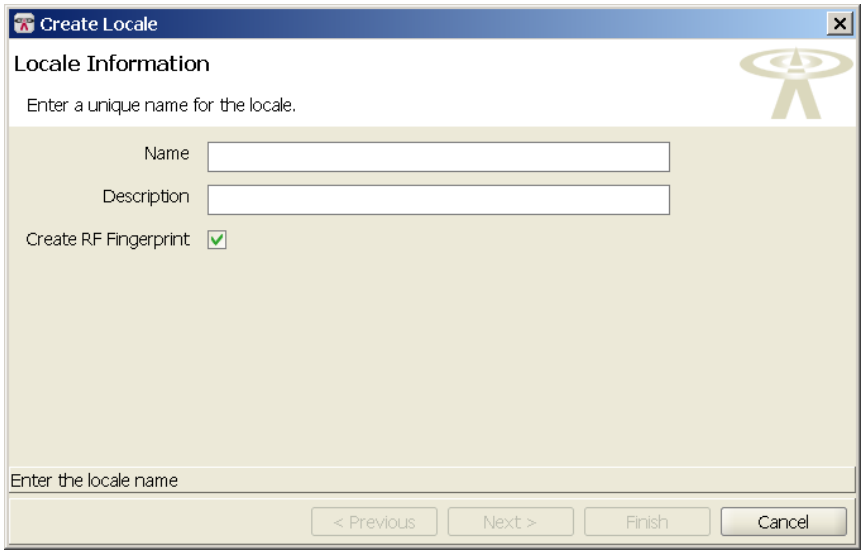
- Platform Management
- Appliance Logs
- Backup and Restore
- Configuration
- Factory Reset
- Schedule Reboot
- System Update
- User Management

Selecting any tasks under **Other**, opens the operating system of the location appliance and you can perform any of these tasks directly on the location appliance.

Creating Locales Using RingMaster

Select an LA-200E from the **Application Servers** list in the **Organizer** panel. The **Task** list is now populated with available tasks to perform on the location appliance. To create a locale, use the following steps:

1. Under **Create**, click **Create Locale**. The **Create Locale Wizard** is displayed.



2. Enter the name and description of the locale in the appropriate fields. **Create RF Fingerprint** is selected by default. If you do not want to create an RF Fingerprint, clear the checkbox. If you

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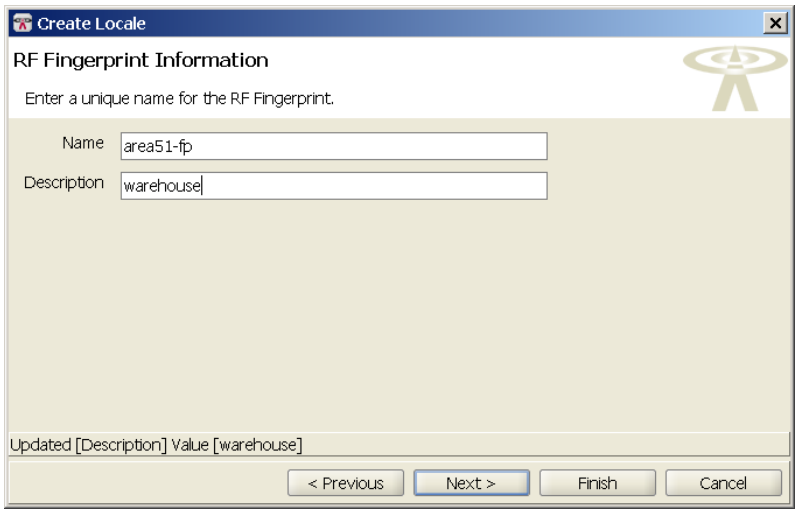
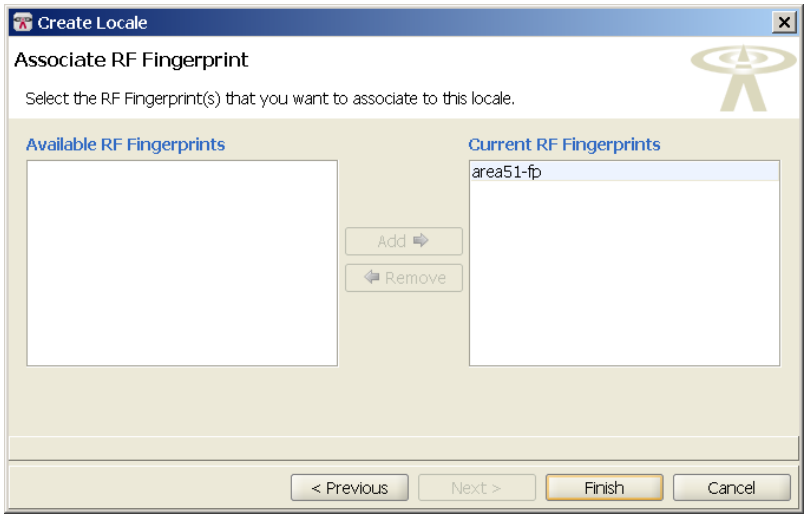
are also using Active Asset on the location appliance, you must follow a specific format for the description. The format is Campus:Building:Floor. Click **Next**.



3. Enter the RF Fingerprint information including Name and Description. Click **Next**.



4. If there are other RF Fingerprints configured on the location appliance, they are displayed in the **Available RF Fingerprints** list. You can select one and add it to the **Current RF Fingerprints** list. You can also remove RF Fingerprints by selecting one from the **Current RF Fingerprints** list and clicking **Remove**.

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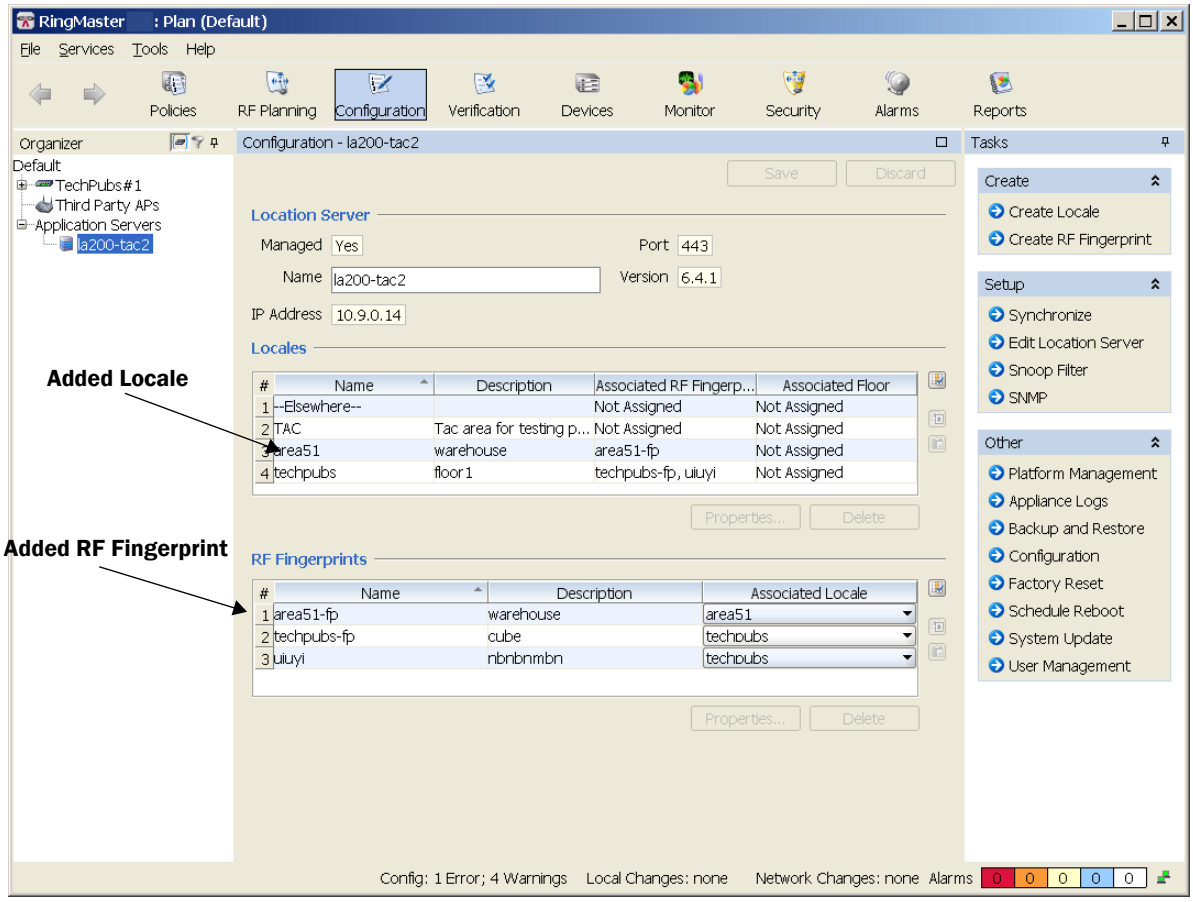
5. Click **Finish** to complete the configuration. The new locale and RF Fingerprints appear in the Location Server and RF Fingerprints section. You can view the properties of a RF Fingerprints by selecting it and then clicking **Properties**.



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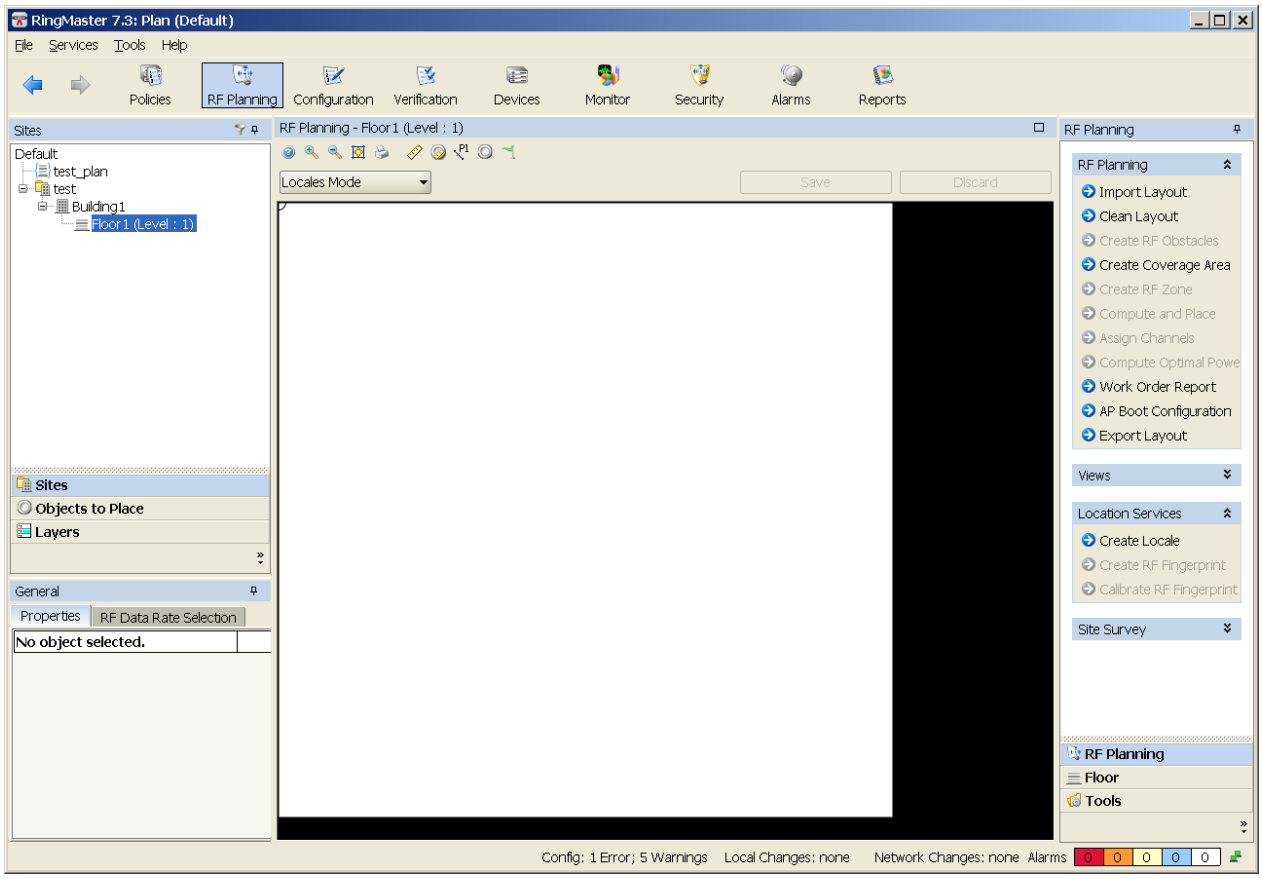
Creating Locales Using RF Planning

You can also create Locales using the RF Planning feature of RingMaster. Click **RF Planning** and select a plan from the **Organizer**. You can also import locales from CAD drawings.



Under **Location Services**, click **Create Locale**. The **Create Locale** wizard is displayed.

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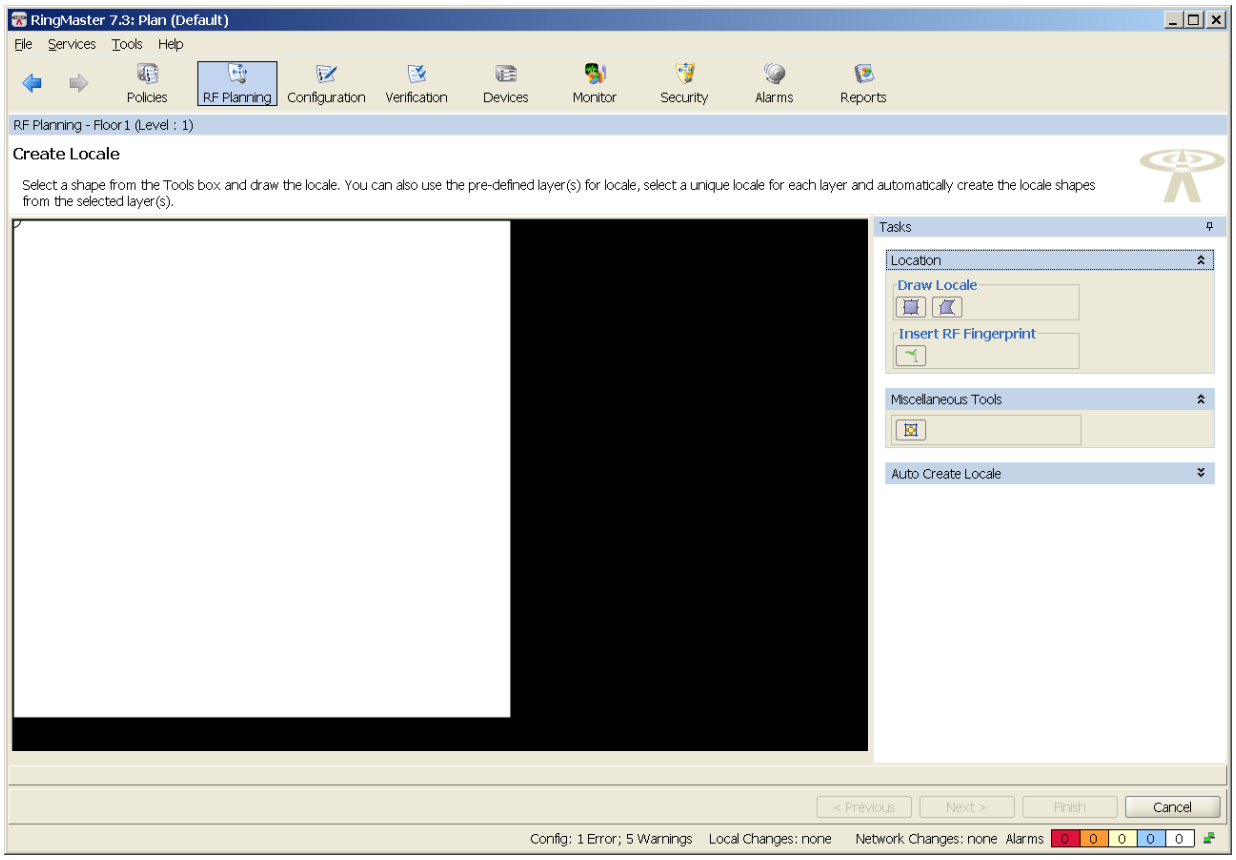
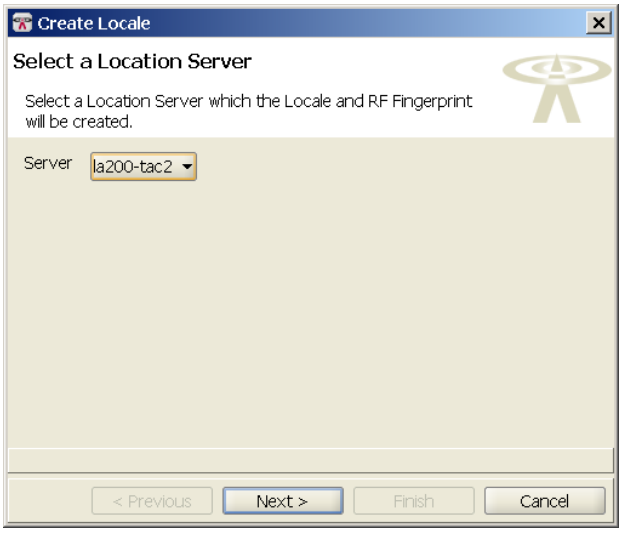


When you use the Drawing tools to draw the Locale, the **Create a Locale** wizard is displayed.



1. Select a Location Server from the list and click **Next**.

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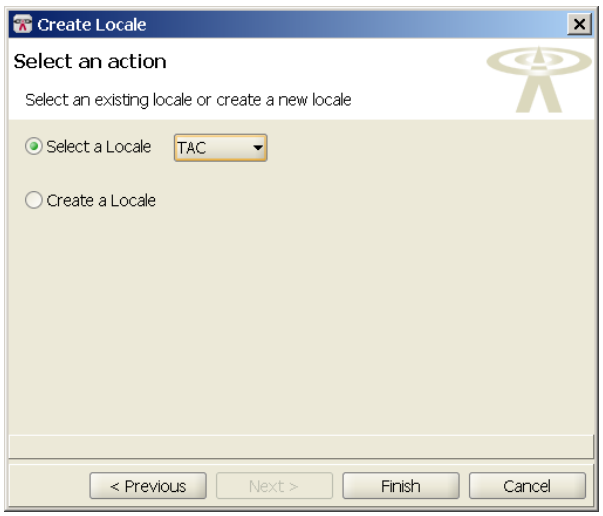
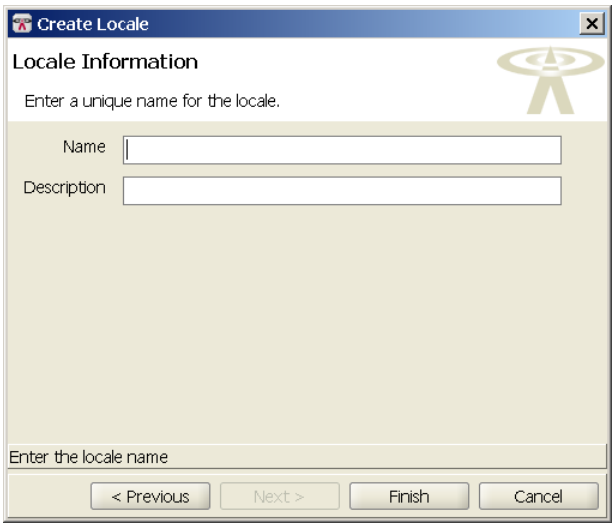


2. You can now select an existing locale or create a new locale. If you select an existing locale, click **Finish** to complete the configuration. If you select **Create a Locale**, click **Next**.



3. Type a name and description of the Locale in the **Name** and **Description** fields. Click **Finish** to complete the configuration.

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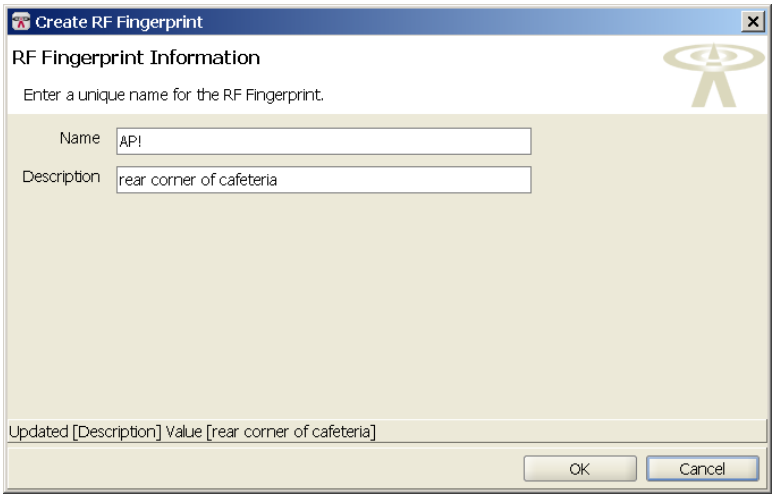
Adding RF Fingerprints Using RF Planning

You can add RF Fingerprints to the Locale you just created by clicking **RF Fingerprint** in the **Task** list. When you move your cursor over the locale, it changes to a crosshair. Click and drag to display the RF Fingerprint wizard.



Enter a name and description for the RF Fingerprint and click **OK**. The RF Fingerprint now appears on the Locale.

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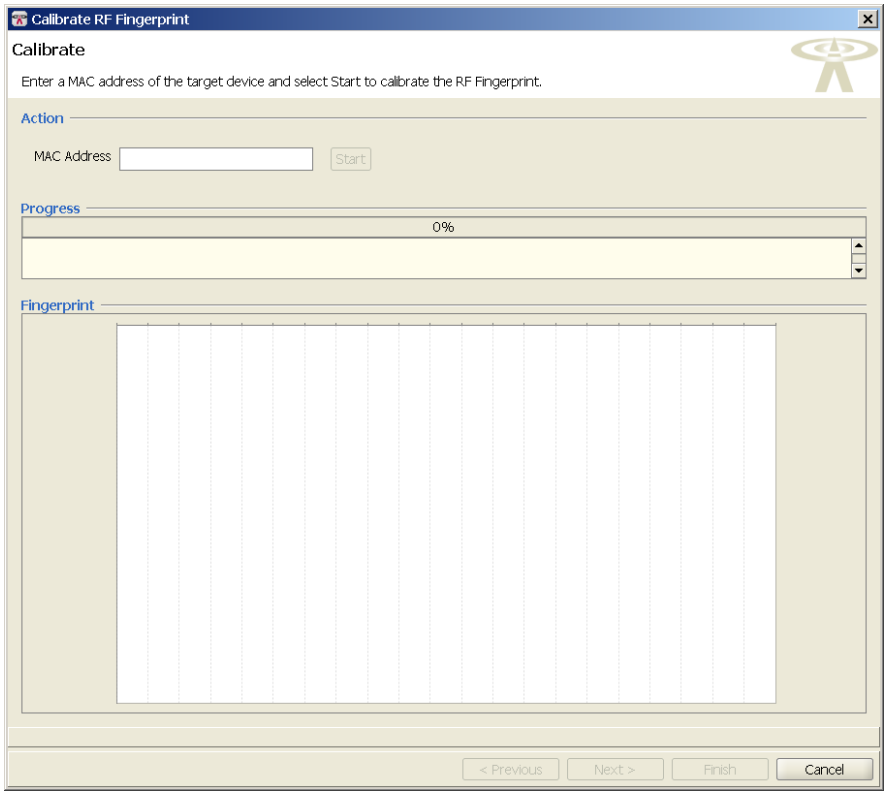
Calibrating RF Fingerprints Using RF Planning

To calibrate an RF Fingerprint, click on the fingerprint icon in the locale to select it. Then click **Calibrate RF Fingerprint**.



Enter the MAC address of the device and click **Start**. You can see the status in the Progress bar. Once the process is complete, you can click **Next** to add it to the locale.

Creating RF Fingerprints

Select an LA-200E from the **Application Servers** list in the **Organizer** panel. The **Task** list is now populated with available tasks to perform on the location appliance. To create a RF Fingerprint, use the following steps:

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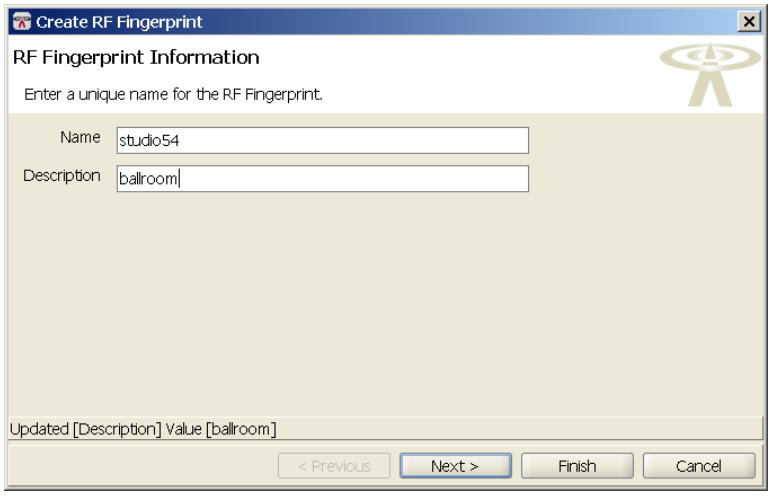
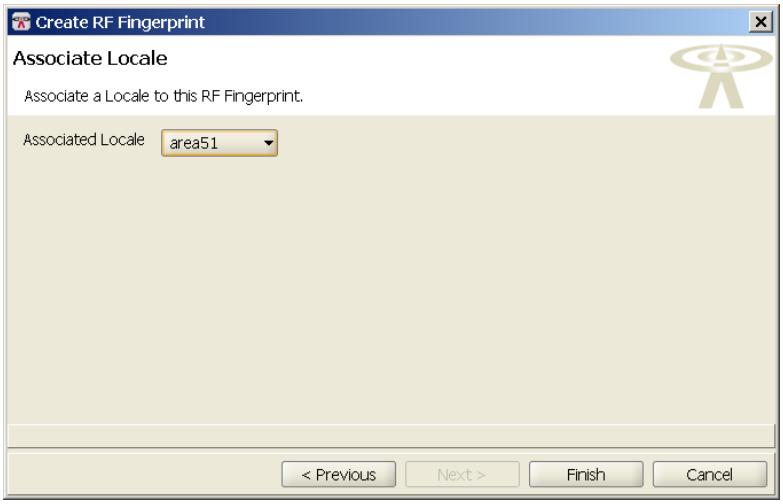
1. Under **Create**, click **Create RF Fingerprint**. The wizard is displayed.



2. Enter a name and description for the RF Fingerprint.
3. Click **Next**.



4. Select a locale from the **Associated Locale** list to associate with the RF Fingerprint.
5. Click **Finish** to complete the configuration.

The RF Fingerprint now appears in the **Locales** list and the **RF Fingerprints** list.

Setting Up a Location Appliance Using RingMaster

Select an LA-200E from the **Application Servers** list in the **Organizer** panel. The **Task** list is now populated with available tasks to perform on the location appliance.

Synchronizing Changes on a Location Appliance using RingMaster

To synchronize configurations on a location appliance, use the following steps:

1. In the **Task** list, click **Synchronize**.

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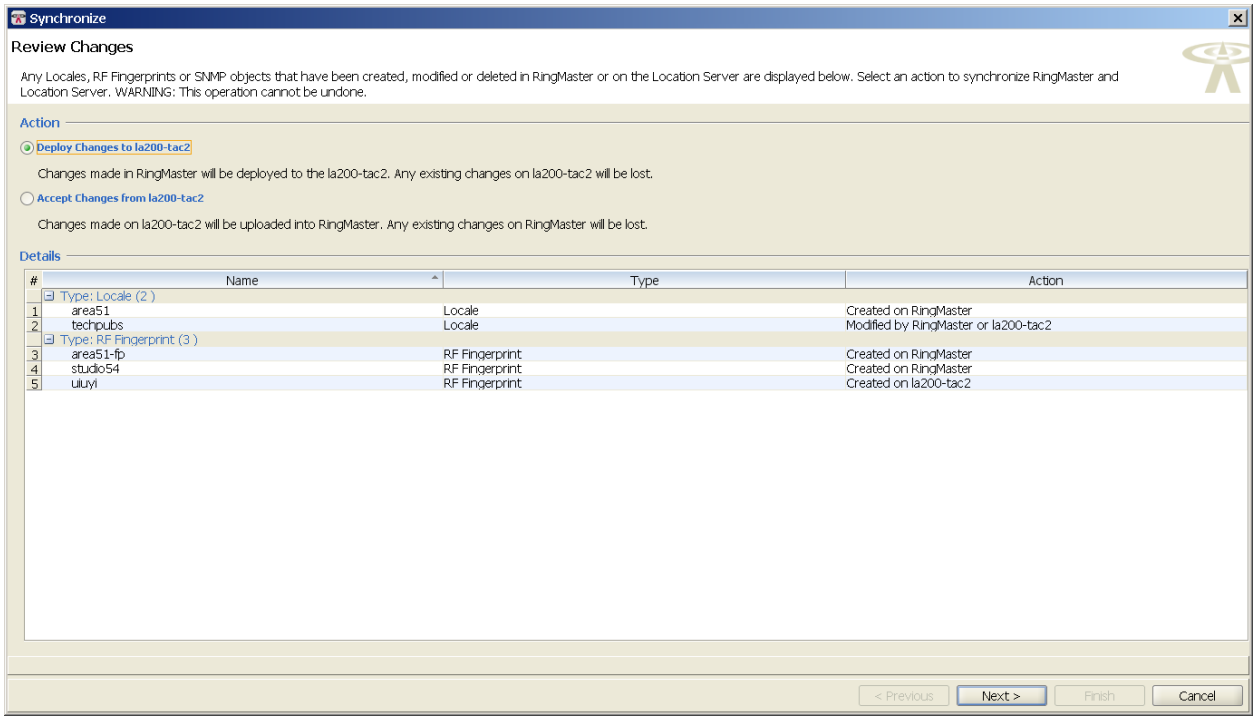
2. The **Review Changes** panel is displayed.


Synchronize
Review Changes
Any Locales, RF Fingerprints or SNMP objects that have been created, modified or deleted in RingMaster or on the Location Server are displayed below. Select an action to synchronize RingMaster and Location Server. WARNING: This operation cannot be undone.
Action
Deploy Changes to la200-tac2
Changes made in RingMaster will be deployed to the la200-tac2. Any existing changes on la200-tac2 will be lost.
Accept Changes from la200-tac2
Changes made on la200-tac2 will be uploaded into RingMaster. Any existing changes on RingMaster will be lost.
Details
Name Type Action
Type: Locale (2)
1 area51 Locale Created on RingMaster
2 techpubs Locale Modified by RingMaster or la200-tac2
Type: RF Fingerprint (3)
3 area51-fp RF Fingerprint Created on RingMaster
4 studio54 RF Fingerprint Created on RingMaster
5 uiuyi RF Fingerprint Created on la200-tac2
< Previous
Next >
Finish
Cancel

3. You can select from two types of action:
   - Deploy Changes to the location appliance - changes made using RingMaster are applied to the location appliance.
   - Accept Changes from the location appliance - changes made on the location appliance are uploaded to RingMaster.

You cannot undo this operation. Once you click **Next**, the changes are synchronized between RingMaster and the LA-200.

4. Click **Next**. The changes are synchronized between RingMaster and the location appliance.
5. Click **Finish** to complete the operation.

The LA-200 image created using RingMaster is transferred to the LA-200 where it is used by other applications such as Active Asset. It is recommended that you create a backup of your current image before transferring the new on to the LA-200.

Editing Location Appliance Attributes Using RingMaster

To edit a location appliance, select it from the list of Application Servers. Then follow these steps:

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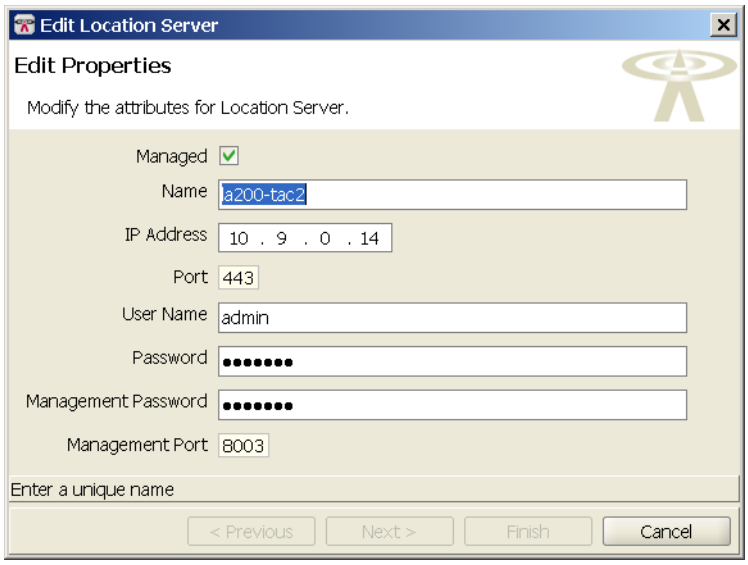
1. Click **Edit Location Server** to display the attributes for the server.

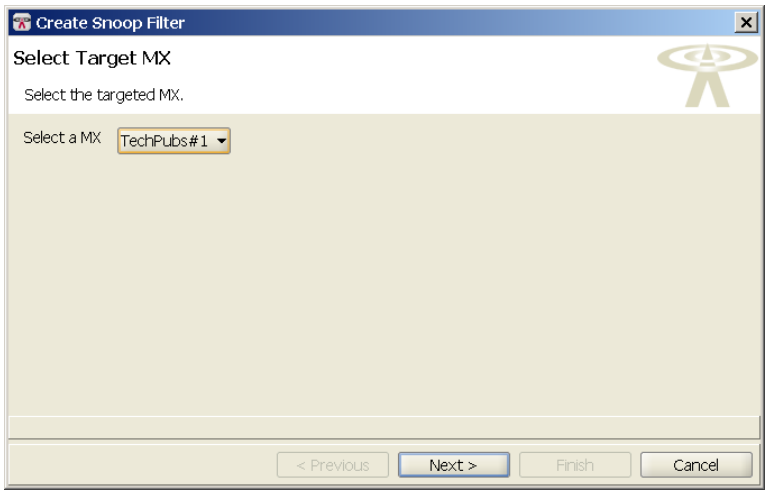


2. You can modify any of the listed attributes, and click **Next**.
3. RingMaster establishes a connection with the location appliance.
4. Click **Finish** to send the changes to the location appliance.

Configuring a Snoop Filter for a Location Appliance

You can configure a snoop filter on an MX using RingMaster and apply it to a location appliance. To configure a snoop filter, follow these steps:

1. In the **Task** list, under **Setup**, click **Snoop Filter**.



2. Select an MX to target from the **Select a MX** list.
3. Click **Next**.

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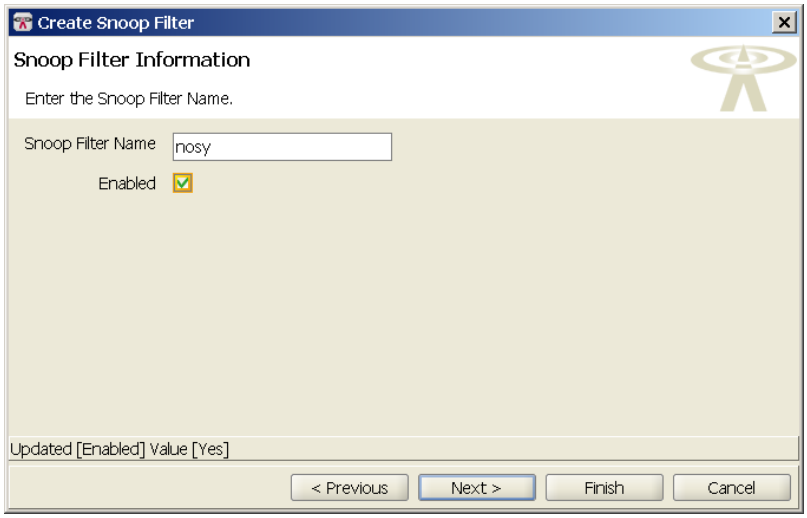
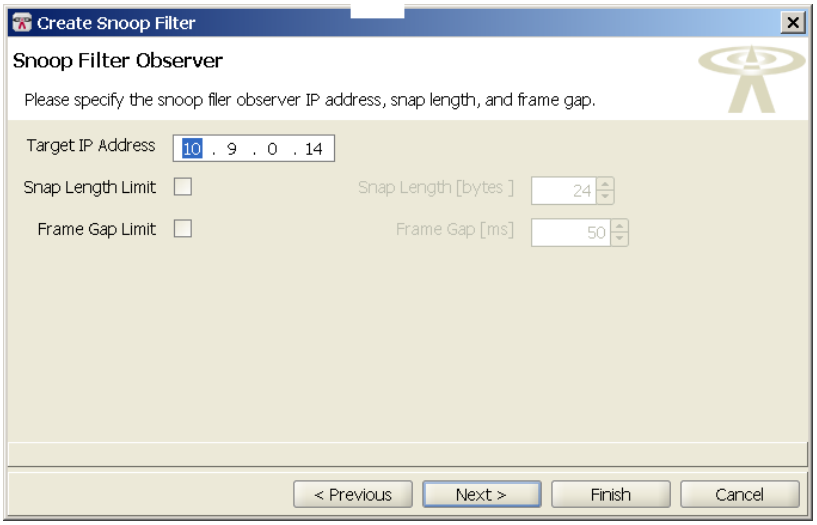
4. If there is an existing Snoop Filter on the MX, you can select it from the **Filters** list. If a Snoop Filter is not configured, you can select **Create a Filter**. Click **Next**.



5. In the **Snoop Filter Name** field, enter a name for the filter. Select **Enabled** to begin using the filter. Click **Next**.



6. Configure the **Snoop Filter Observer**. You must specify the following information:
   - Target IP Address
   - Snap Length Limit (optional)
   - Frame Gap Limit (optional)

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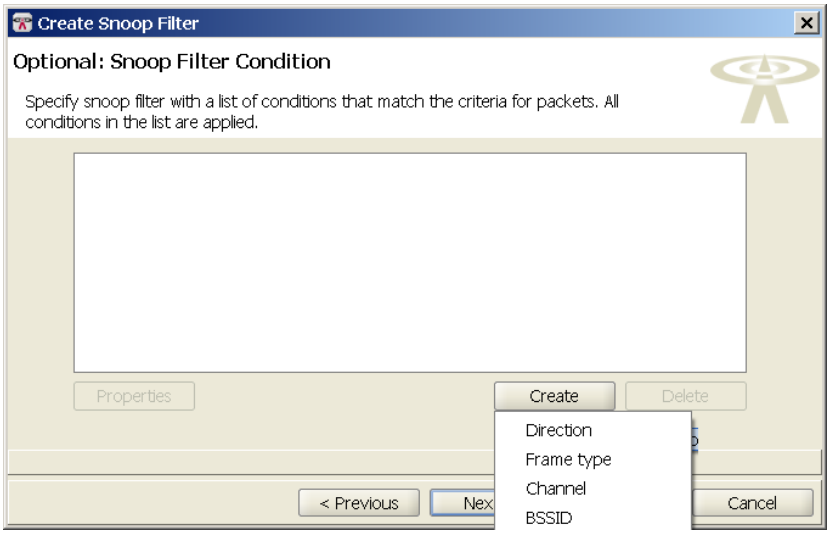
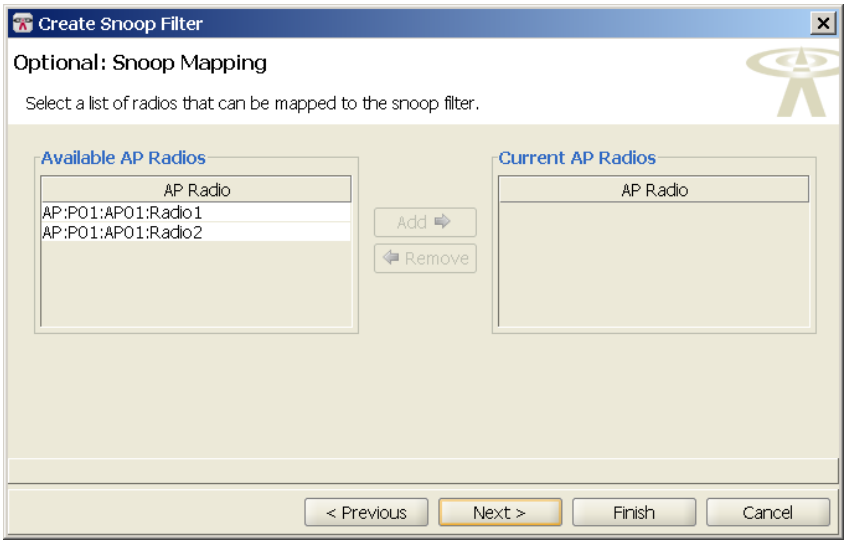
7. Click **Next**.



8. Optionally, you can create **Snoop Filter Conditions** by specifying a list of conditions that match the criteria for packets. The following conditions can be added to the Snoop Filter:
   - Direction
   - Frame Type
   - Channel
   - BSSID
   - Source MAC
   - Destination MAC
   - Host MAC
   - MAC Pair

   When you select a condition, a list of attributes is displayed that can be applied to it. Click **Next.**



9. You can also configure optional **Snoop Mapping** by selecting radios on an MP to map the **Snoop Filter**. Click **Next**.

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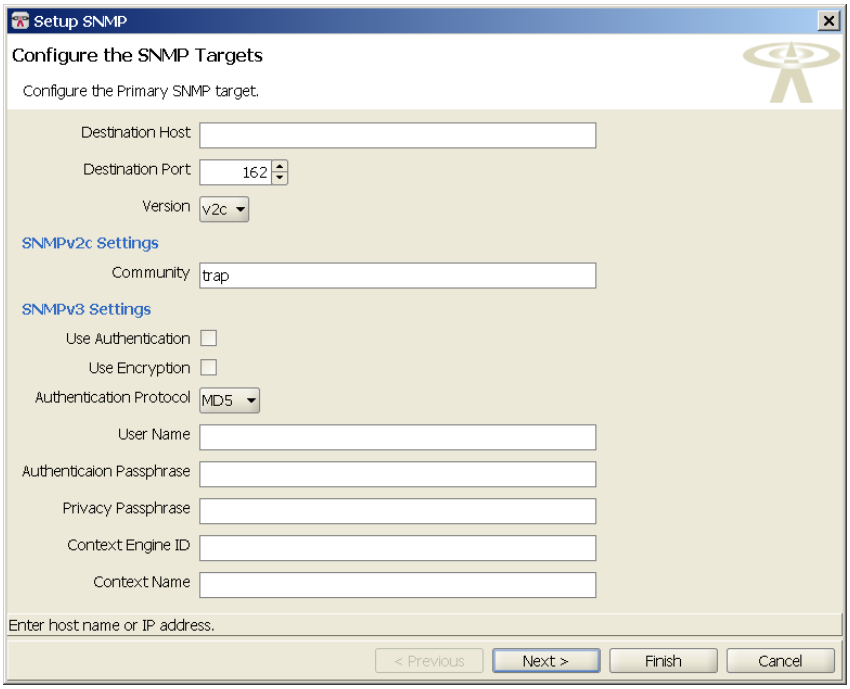
10. Additionally, you can map a Snoop Filter to a specific radio profile. Select one from the **Available Radio Profiles** list and click **Add** to move it into the **Current Radio Profiles** list.
11. Click **Finish** to complete the Snoop Filter configuration.

Configuring SNMP for a Location Appliance

You can configure SNMP settings for the Location Appliance using the RingMaster interface. Select a Location Appliance from the list in the **Organizer** panel and then click **SNMP**.



You need the following information to configure SNMP targets on the Location Appliance:

- Destination Host
- Destination Port
- SNMP Version

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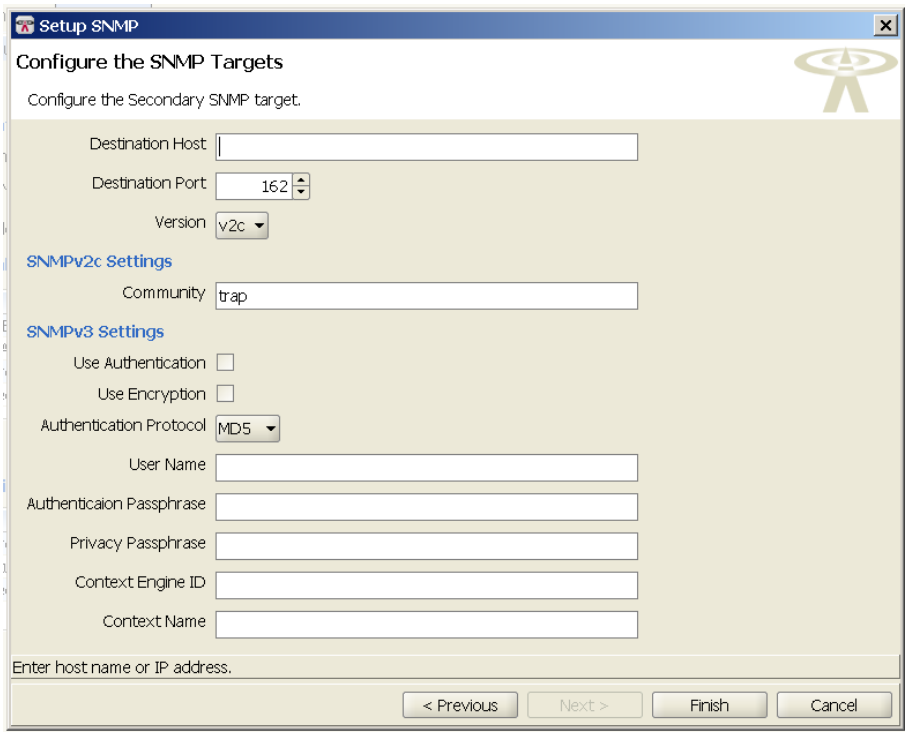
If you select SNMP Version v2c, then you configure the SNMPv2c Settings. If you select SNMPv3, then you configure the SNMPV3 settings. Click **Next** to continue with the configuration.



If you a secondary SNMP target, you can configure it by entering the appropriate information. Click **Finish** to complete the configuration.

All tasks listed under **Other** are performed on the LA-200E using the LA-200E user interface. Consult the Juniper LA-200 documentation to perform any of these tasks.

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Mesh and Outdoor Planning

The next section provides an overview of Mesh services, and the remainder of the chapter describes Outdoor Area planning.

WLAN Mesh Services Overview

WLAN mesh services allow an AP to provide wireless services to clients without a wired interface on the AP. Instead of a wired interface, there is a radio link to another AP with a wired interface.There are three components to a mesh deployment:

- **Mesh Portal** — The AP has a wired connection (it has power and ethernet connection).
- **Mesh AP** — The wireless AP without a wired connection (untethered)
- **Mesh Link** — A Layer 2 transparent bridge with the Mesh Portal and the Mesh AP as endpoints.

WLAN mesh services can be used at sites when running Ethernet cable to a location is inconvenient, expensive or impossible. Note that power must be available at the location where the Mesh AP is installed. For example, providing wireless coverage over a parking lot is a useful application of mesh. Light poles can provide power but do not have Ethernet and are too expensive to wire. Mesh APs can be mounted on light poles and connect to a mesh portal AP on the side of the building.

A client is associated with a *Mesh AP*, an AP without a wired interface to the network. The Mesh AP is configured to communicate with a *Mesh Portal*, an AP with wired connectivity to an MX. Communication between the Mesh AP and the Mesh Portal takes place using over a secure radio link (a *Mesh Link*). When associated with the Mesh AP, the client has the same connectivity to the network as when associated with an MP having a wired link.

The Mesh AP and Mesh Portal AP are dual-radio APs. One radio (for example, the 802.11a radio) can be used for Mesh Link communications, using an SSID reserved for this purpose, while the Mesh AP can use the other radio for client associations in the same manner as a non-Mesh AP.

The Mesh Portal AP beacons a mesh services SSID on the radio used for the Mesh Link. When the Mesh AP is booted, the AP searches for an AP beaconing the mesh services SSID. The AP selects the Mesh Portal AP with the greatest signal strength, then establishes a secure connection to the Mesh Portal SSID. Once this connection is established, clients can associate with the Mesh AP.

WLAN mesh services are supported on the MP-620, MP-422 and MP-432 only.

Mesh Services Enhancements

Multihop is now available when you configure Mesh Services. You can configure up to 10 Mesh Portals and 4 Mesh APs per Mesh Portal. Also, a single Mesh AP can perform two roles: Mesh Portal and Mesh AP.

Mesh Services reliability is improved by adding the following enhancements:

- Improved transmission of station session record.
- Ability to manage link loss between Mesh Portals and Mesh APs.
- Improved management of duplicate messages for SSR updates from multiple Mesh APs.

Mesh portal selection has improved by scanning for Mesh Link SSIDs and sorting them by RSSI values. The Mesh AP establishes a link using the RSSI values in descending order. If all attempts fail, the Mesh AP scans from the beginning of the table. After 60 seconds and no link is established, the Mesh AP reboots.

If the Mesh Link is using a DFS channel, then the Mesh Link has a timeout of 140 seconds to allow for DFS channel assessment.

Mesh Topologies

There are a variety of topologies possible using the new Mesh features in *RingMaster 7.4* .

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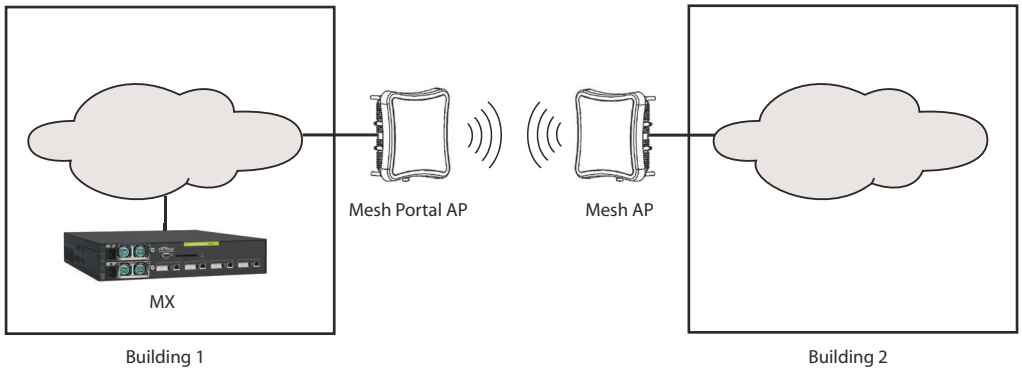
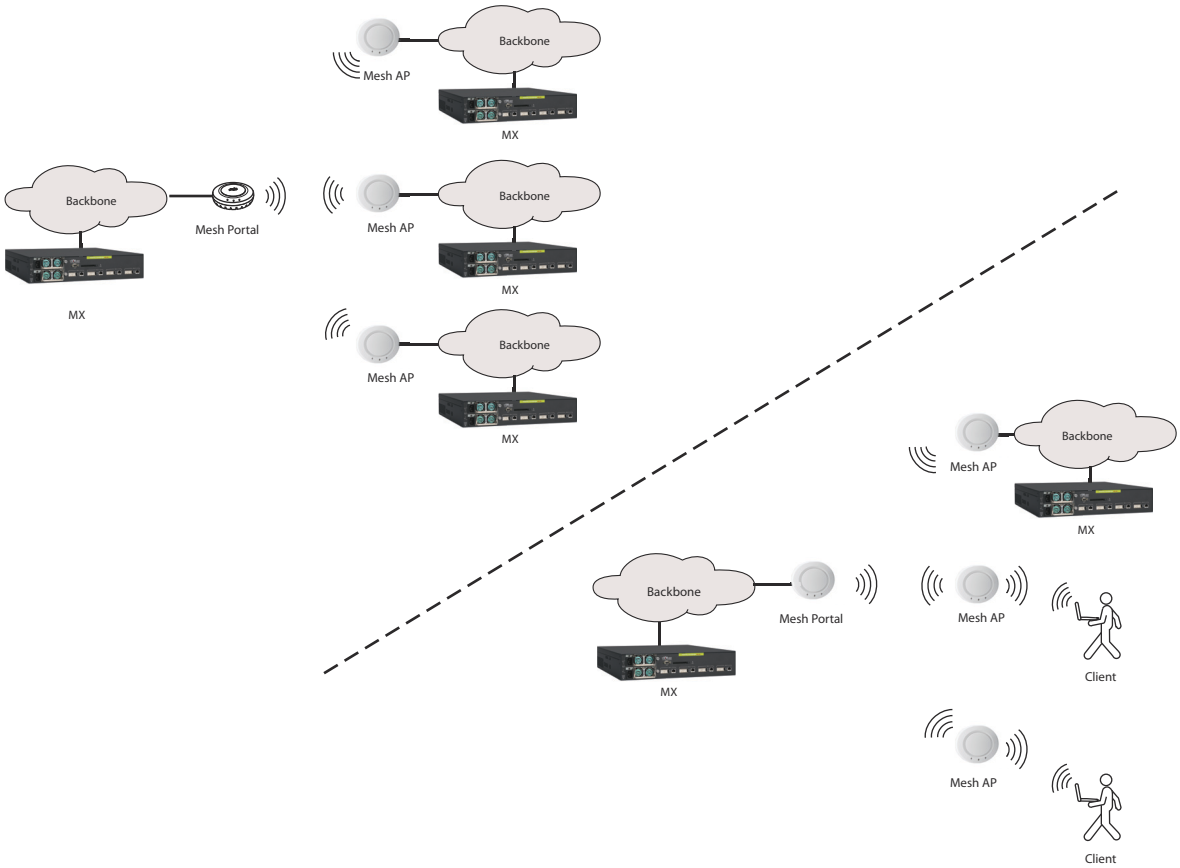
Bridge Topology

Mesh APs and Mesh Portal APs can be used to provide an RF “bridge” between two buildings.Bridges are useful in extending the wired infrastructure of one site to another in close proximity via a wireless link. APs participating in bridge mode are dedicated to that connection and do not provide wireless services to clients.



Multipoint Topology

What is referred to above as Bridge Technology can be extended to have more than one Mesh AP having an RF link to a single Mesh Portal AP. The Mesh Portal has a configuration called a Fan Out of 3 in both the upper and the lower drawing.



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Definitions

- **Mesh portal AP** — An AP configured to provide a wireless mesh service to other APs.
- **Mesh AP** — An AP configured to use a wireless mesh service in order to provide wireless services to clients.

A mesh AP can simultaneously be a mesh portal AP.

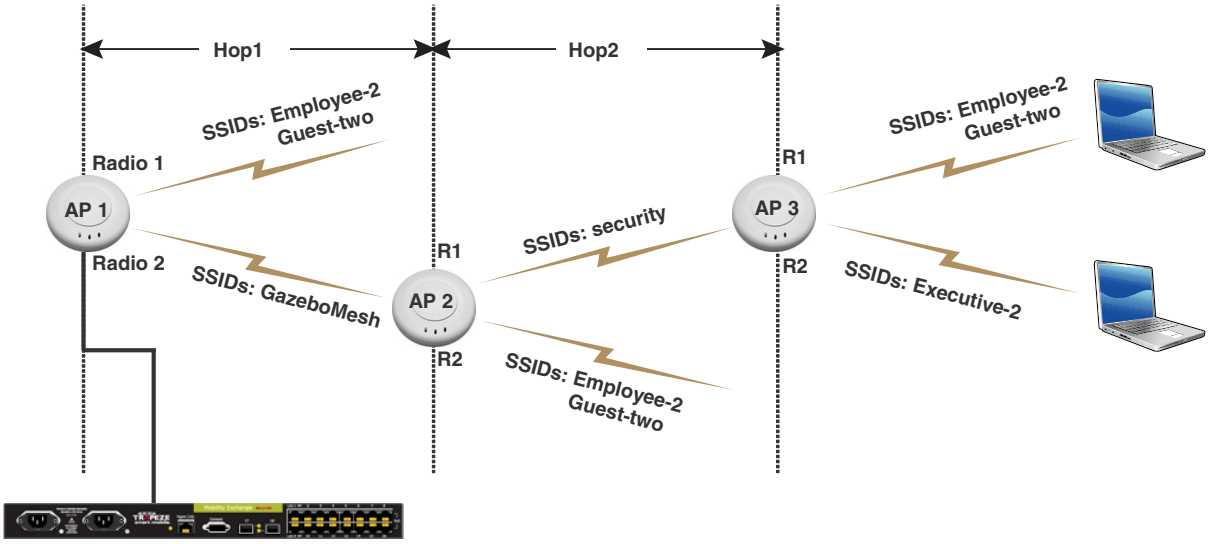
- **Fan out** — The number of APs connected as mesh APs to a given mesh portal.
- **Hop count** — The number of wireless links that a mesh AP must take before reaching a mesh portal with a wired connection to the network.

General Considerations

Mesh topology can consume a large amount of bandwidth on the mesh backhaul link. Fanout uses bandwidth to the mesh portal AP, and a large fanout will quickly consume bandwidth. Hop count uses bandwidth to the mesh portal AP but also increases latency to/from the client. Where reliability is a factor, it may be important to have multiple/redundant mesh portal APs in the event of a failure or interference renders one or more mesh portals AP inoperative.

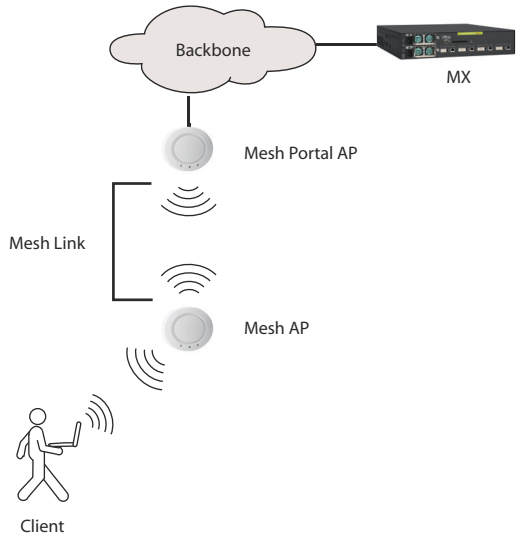
Multi-hop Topology

It is possible to set up a two-hop mesh network as shown below:



Backhaul Topology

Some networks require wireless backhaul. In this case, outdoor APs (known as **Mesh Portal APs**) are connected to a network via an Ethernet connection and other APs (known as **Mesh APs**) are connected via a wireless backhaul link.



Planning Outdoor Wireless Coverage

RingMaster 7.4 allows for planning of networks including outdoor wireless service areas in addition to indoor areas. Outdoor areas can now be defined using RF Planning tools for coverage, and capacity calculations are now possible.

Special considerations and requirements for outdoor RF planning are as follows:

- Free space path loss is different for different types of Outdoor Areas.
- Additional factors such as terrain and climate and atmospheric conditions come into play.
- RF Obstacles now include buildings, etc.
- Mobility Point heights can vary greatly during planning.
- Manual placement of APs on a network plan may be required.
- External antennas are the default for outdoor RF planning.

Create Outdoor Area Wizard

For outdoor planning, *RingMaster* has added a **Create Outdoor Area** wizard to assist in initial setup of outdoor wireless coverage. After you add a site to a Network Plan, click on its icon and then click **Create Outdoor Area** in the **Tasks** panel to begin setup of an Outdoor Area. You see the following dialog:

1. Enter an area name — For example, **Campus**. Click **Finish**.

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Mesh Planning Wizard

The RF Planning wizard includes enhancements to RF planning functionality that allow you to perform each step of the planning process with task prompts. The RF Planning wizard provides the following process with the option to save the configuration and complete it at another time:

- **Import Layout/Drawing**
- **RF Obstacles**
- **Coverage Areas**
- **Compute and Place APs**
- **Channel Assignment**
- **Optimal Power Computation**

Outdoor Areas

RingMaster allows you to define Outdoor Areas as part of a site, and allows you to perform:

- Basic coverage and capacity calculations
- Wireless backhaul and other link calculations, and
- RF visualizations for these areas.

The MP-620 is preferred for an outdoor environment. You can use Juniper indoor APs with external antennae — for example, mounting an MP-422 on a wall and using conduit to connect an outside external antenna to the AP.

The RF planning **Coverage Area** wizard asks you whether mesh services are desired or not. If they are, you select a technology type (802.11a, 802.11b, or 802.11g) to be used for mesh backhaul. Additionally, this wizard requires you to specify a technology to be used by the wireless clients in the outdoor coverage area. The choices (802.11a, 802.11b, or 802.11g) are complementary to that defined for backhaul coverage.

The process to create Mesh Services is as follows:

1. Select the **RF Planning** button in the Main window.
1. Click on a site in the **Organizer** panel and select **Create Outside Area** in the **Tasks** panel.
2. We begin by importing a file for use in creating an Outside Area. As an example of Mesh planning, the window below shows an imported **.gif** file for an Outside Area named **Campus**

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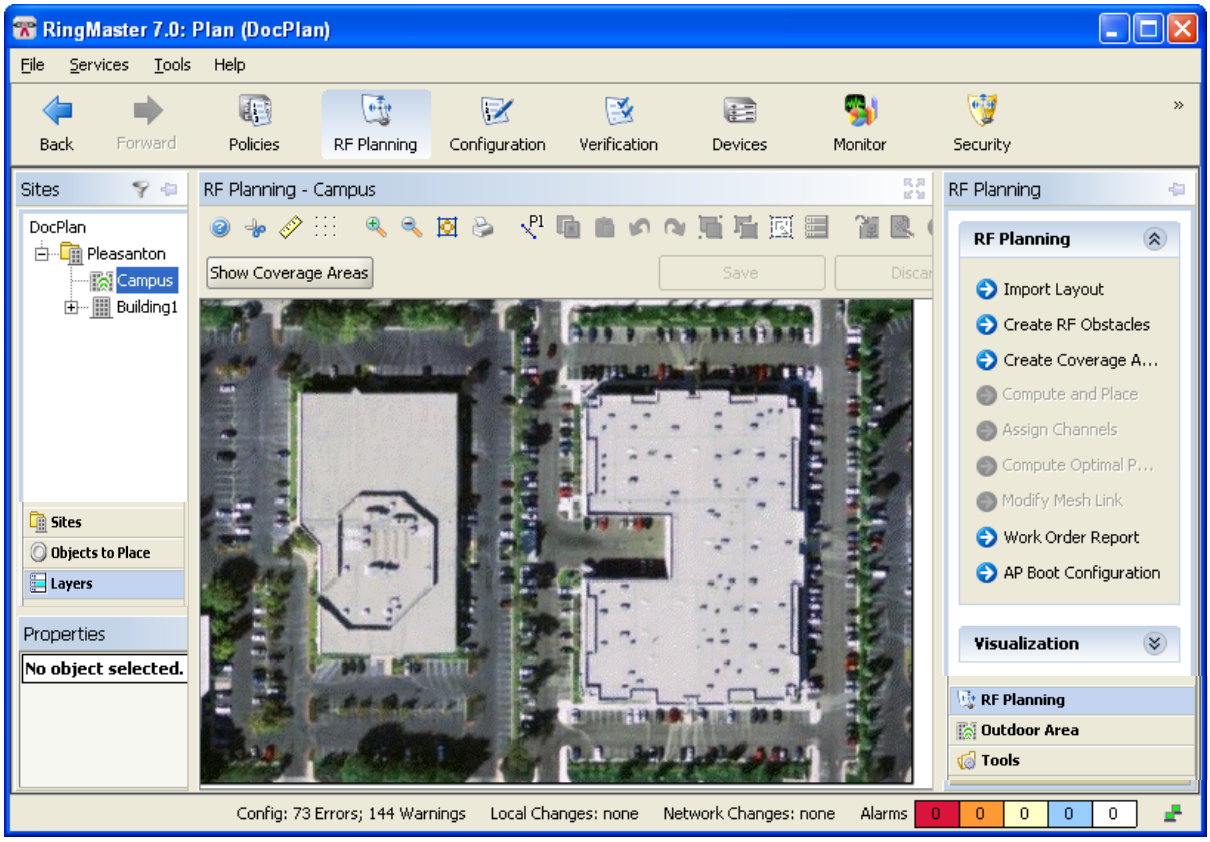
that includes two buildings and associated parking lots where we want to provide coverage. (This is a GIF screen grab from *Google Earth*.)



3. Set the scale and crop the drawing if required and click **Next**.

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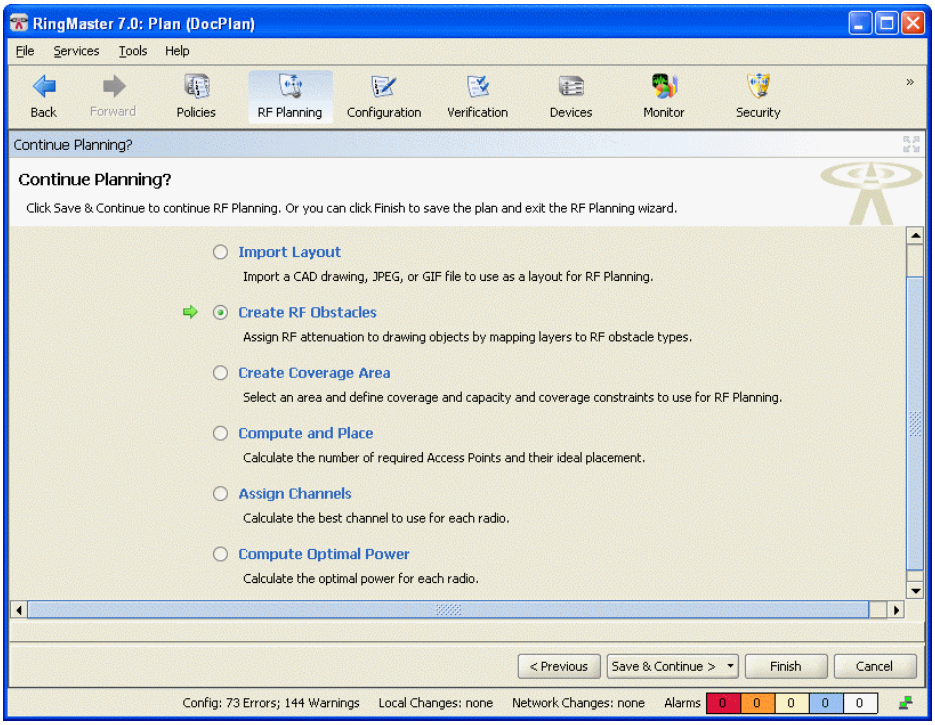
4. You see the **Continue Planning?** dialog with **Create RF Obstacles** selected. Click **Save and Continue**.



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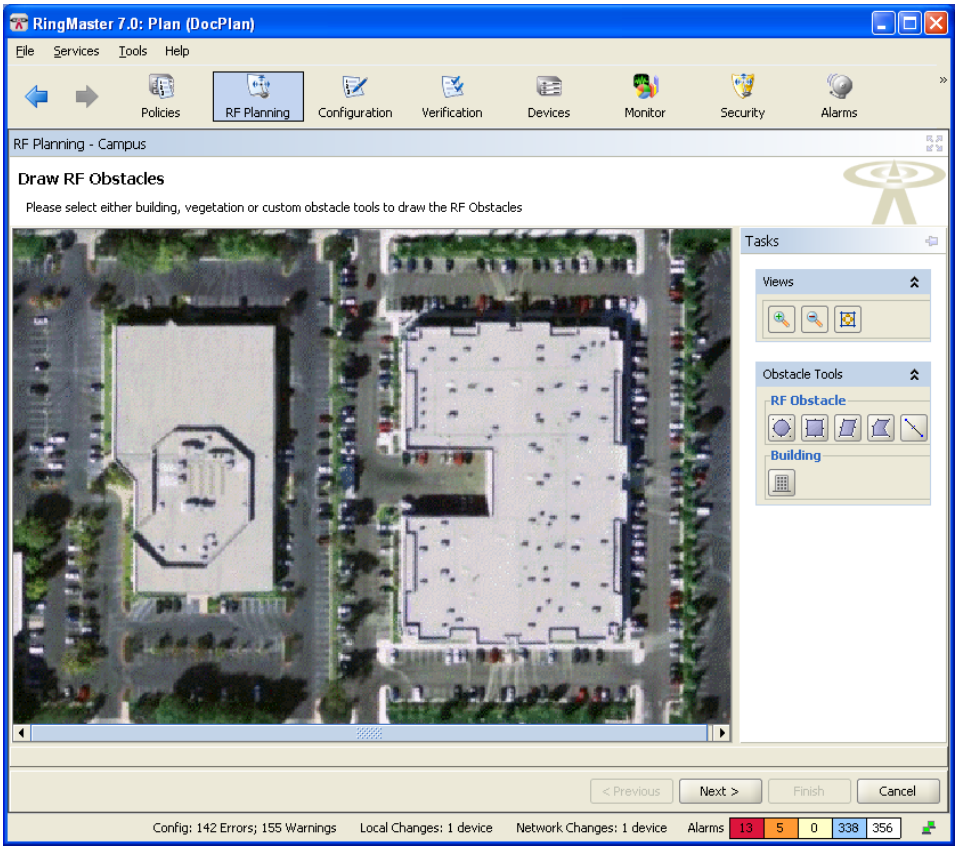
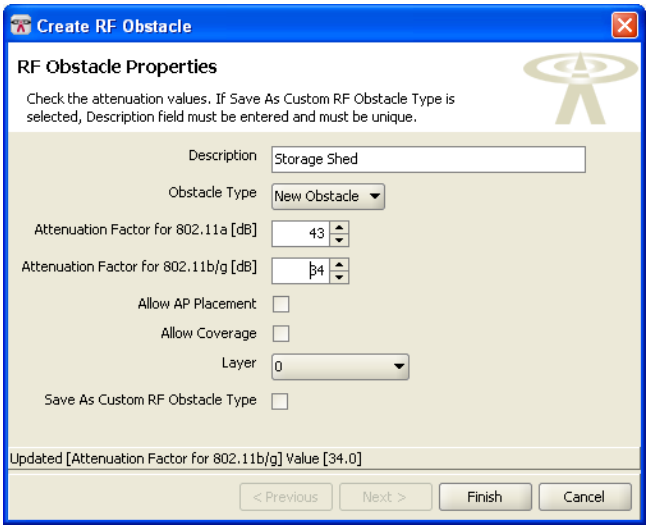
5. You now see a **Draw RF Obstacles** window. Use drawing tools to create RF obstacles or use the **Building** icon to add buildings.



If you create an obstacle using tools other than the **Building** icon, you draw an area, and when you release your mouse from drawing the area you see the following dialog:



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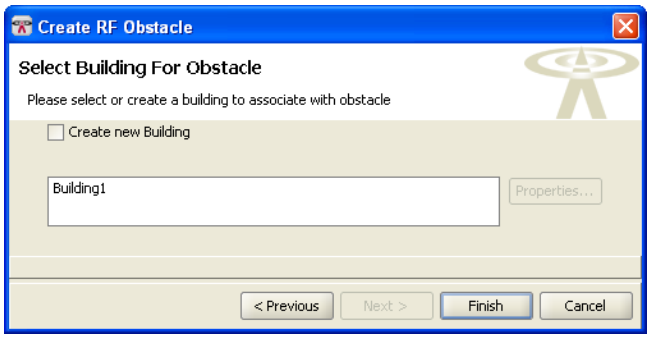
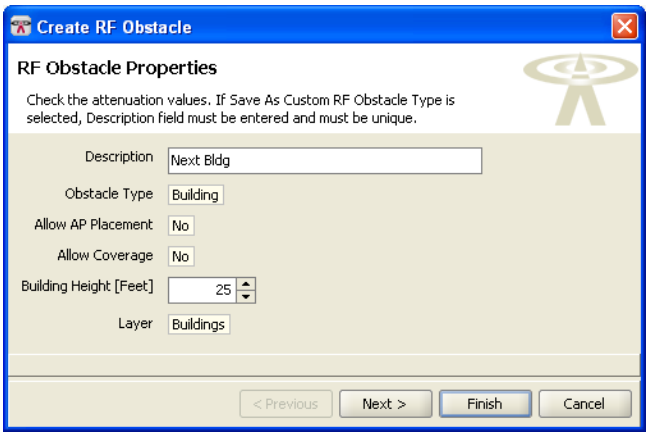
Fill in a description of this obstacle and make other selections shown in the dialog. Click **Finish**.



If you select the **Building** icon, your cursor becomes “crosshairs” and you outline the building shape you wish to create, clicking at any corner or direction change points, and then right-click to see the dialog below Click **Next** and you will see the dialog below.



6. You can create a new building here by clicking the checkbox and following subsequent dialogs, or click on the name listed and click **Finish**.

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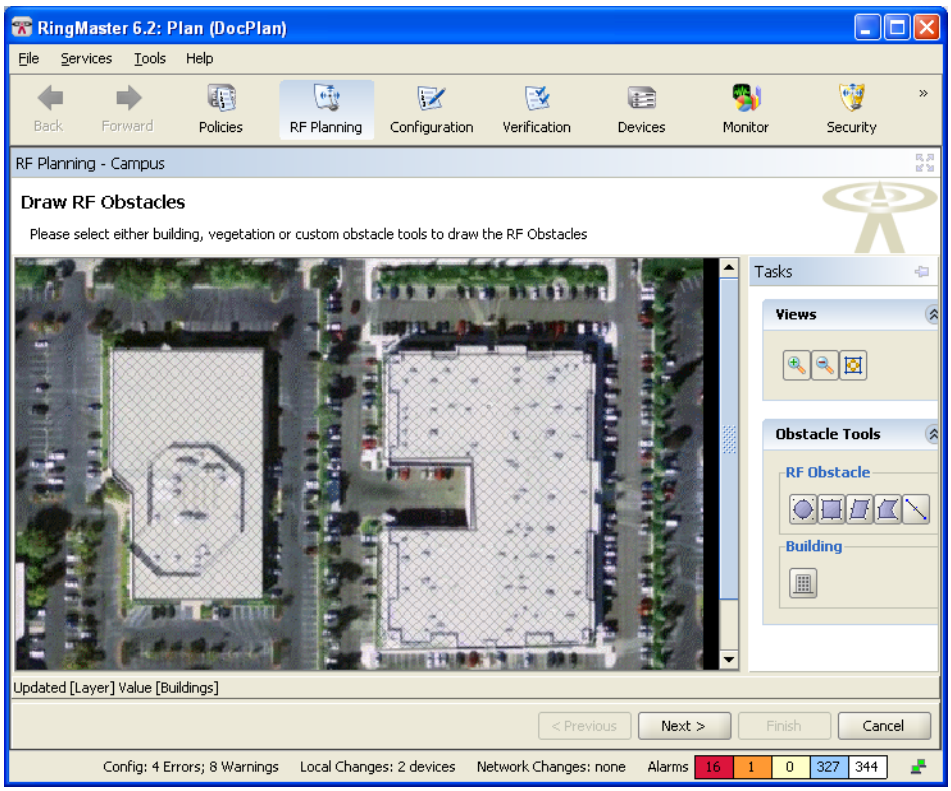
After creating all RF obstacles of this type, these created obstacles are shown with cross-hatching defining their shapes. Click **Next.**



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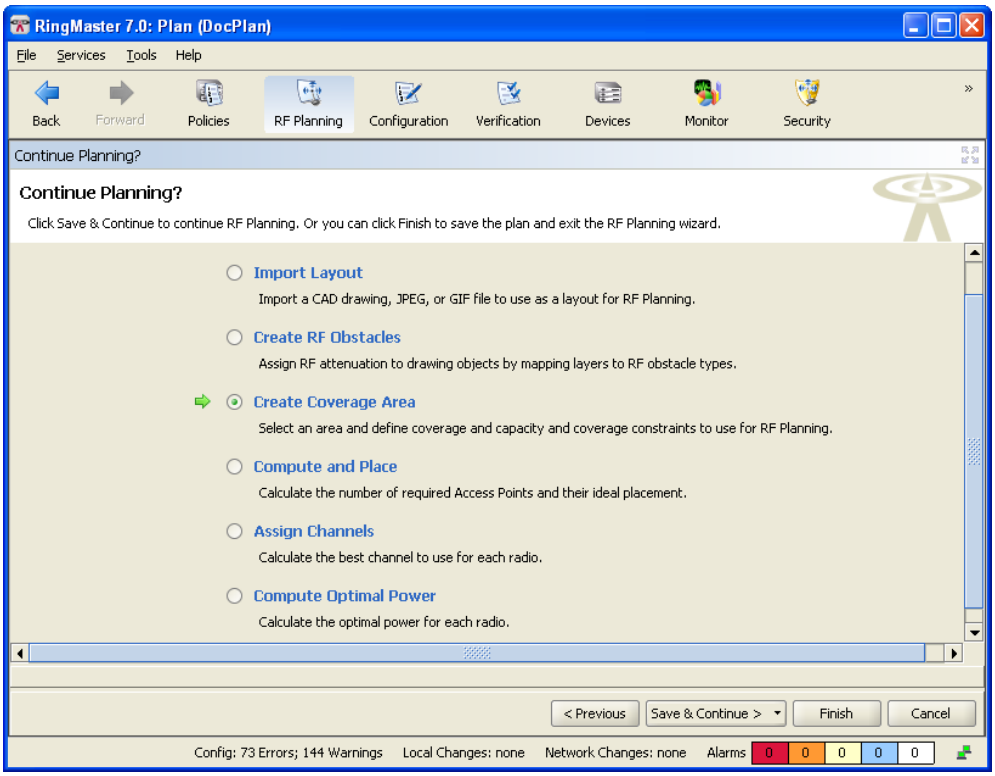
7. You now see the **Continue Planning?** window with **Create Coverage Area** selected.



Click **Save and Continue** to continue the wizard.

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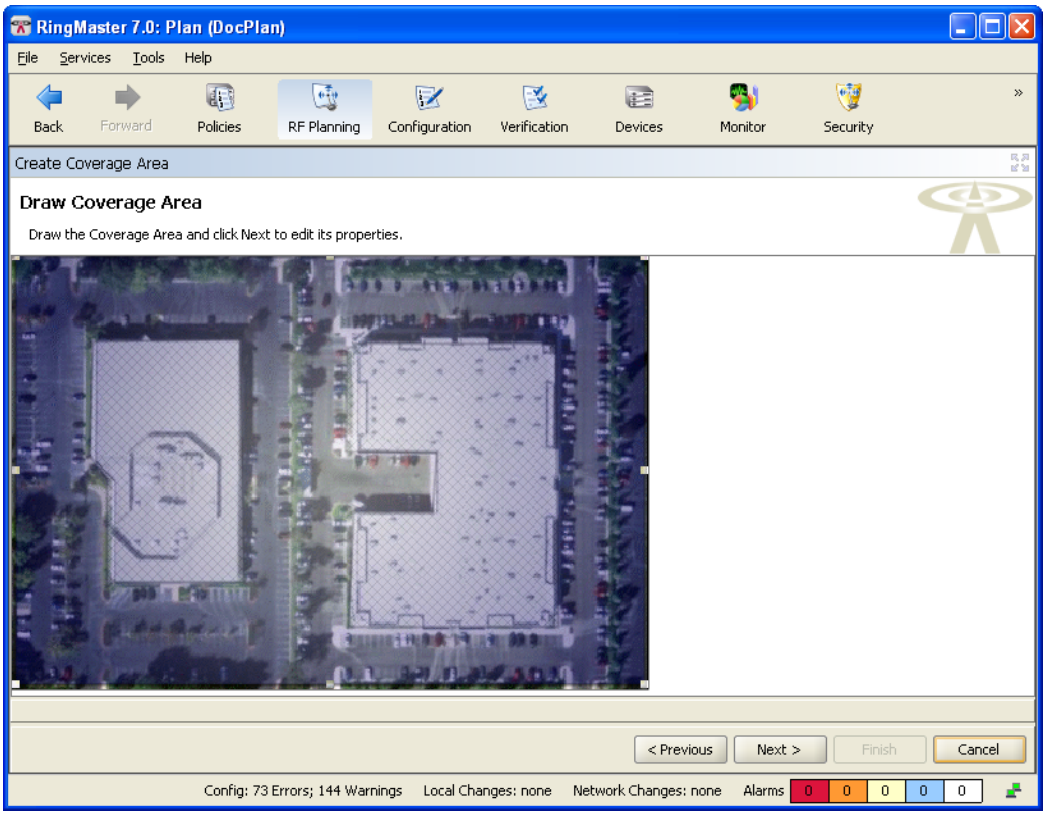
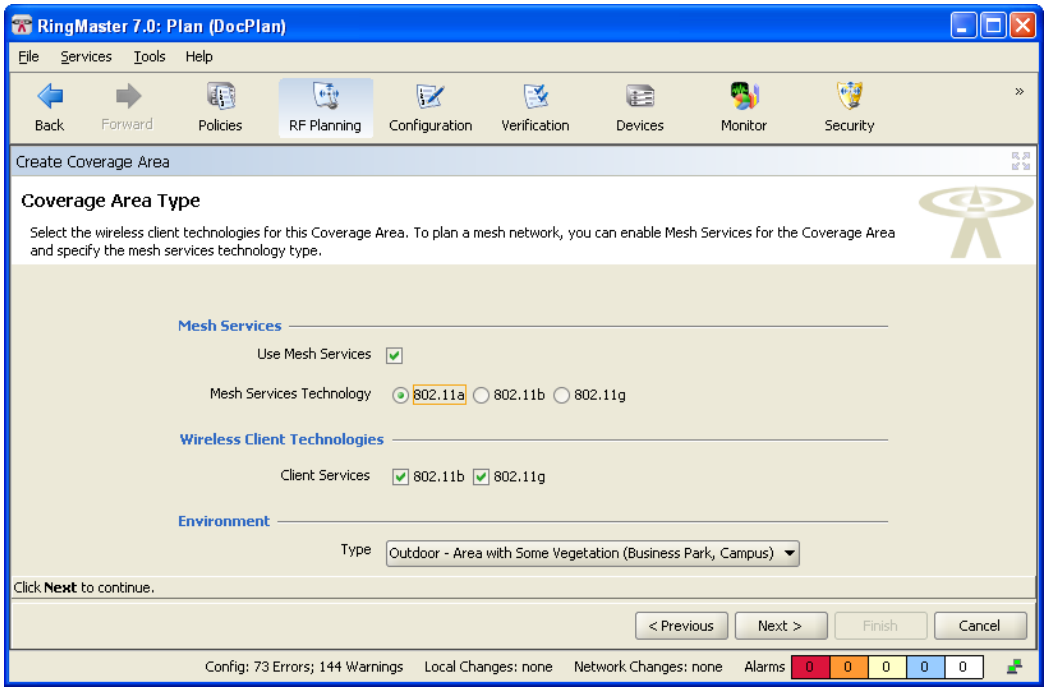
8. You see the **Draw Coverage Area** window is displayed, where you select a shape tool and click **Next**. You then draw a coverage area, which in the example below includes all the parking lots surrounding our two buildings. Click **Next**.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security
Create Coverage Area
Draw Coverage Area
Draw the Coverage Area and click Next to edit its properties.
< Previous Next > Finish Cancel
Config: 73 Errors; 144 Warnings Local Changes: none Network Changes: none Alarms 0 0 0 0 0

9. You now see the **Coverage Area Type** window, where you define **Mesh Services**, **Wireless Clients**, **Technologies** and **Environment Type**.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security
Create Coverage Area
Coverage Area Type
Select the wireless client technologies for this Coverage Area. To plan a mesh network, you can enable Mesh Services for the Coverage Area and specify the mesh services technology type.
Mesh Services
Use Mesh Services
Mesh Services Technology 802.11a 802.11b 802.11g
Wireless Client Technologies
Client Services 802.11b 802.11g
Environment
Type Outdoor - Area with Some Vegetation (Business Park, Campus)
Click Next to continue.
< Previous Next > Finish Cancel
Config: 73 Errors; 144 Warnings Local Changes: none Network Changes: none Alarms 0 0 0 0 0

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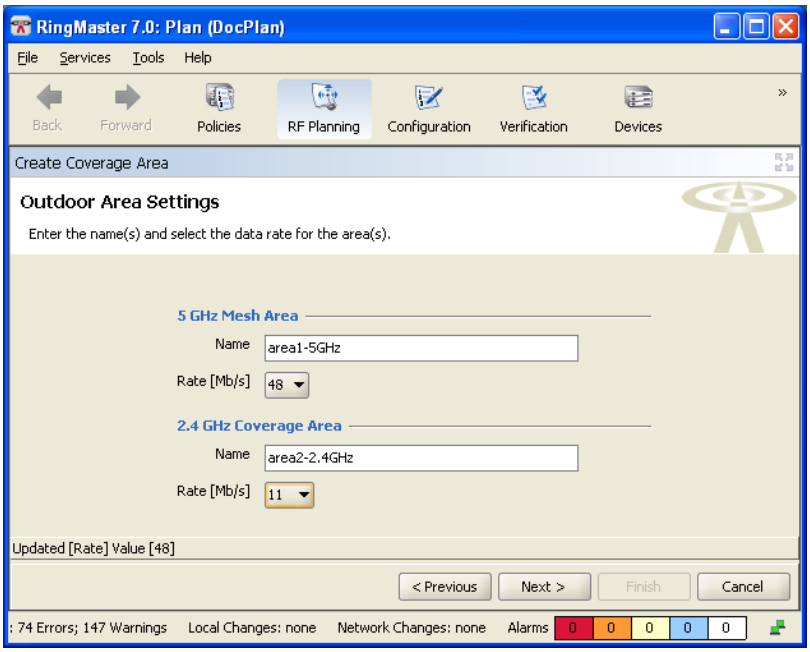
Make selections and click **Next**. The next window depends on whether you click on the **Use Mesh Services** ckeckbox or not. If you do NOT select this checkbox, go to step 10 and if do DO select this checkbox go to step 11.

10. Name and set rates for the two technology coverage areas. Make selections and click **Next**. You will see the dialog in step 11.



Make selections and click **Next**.

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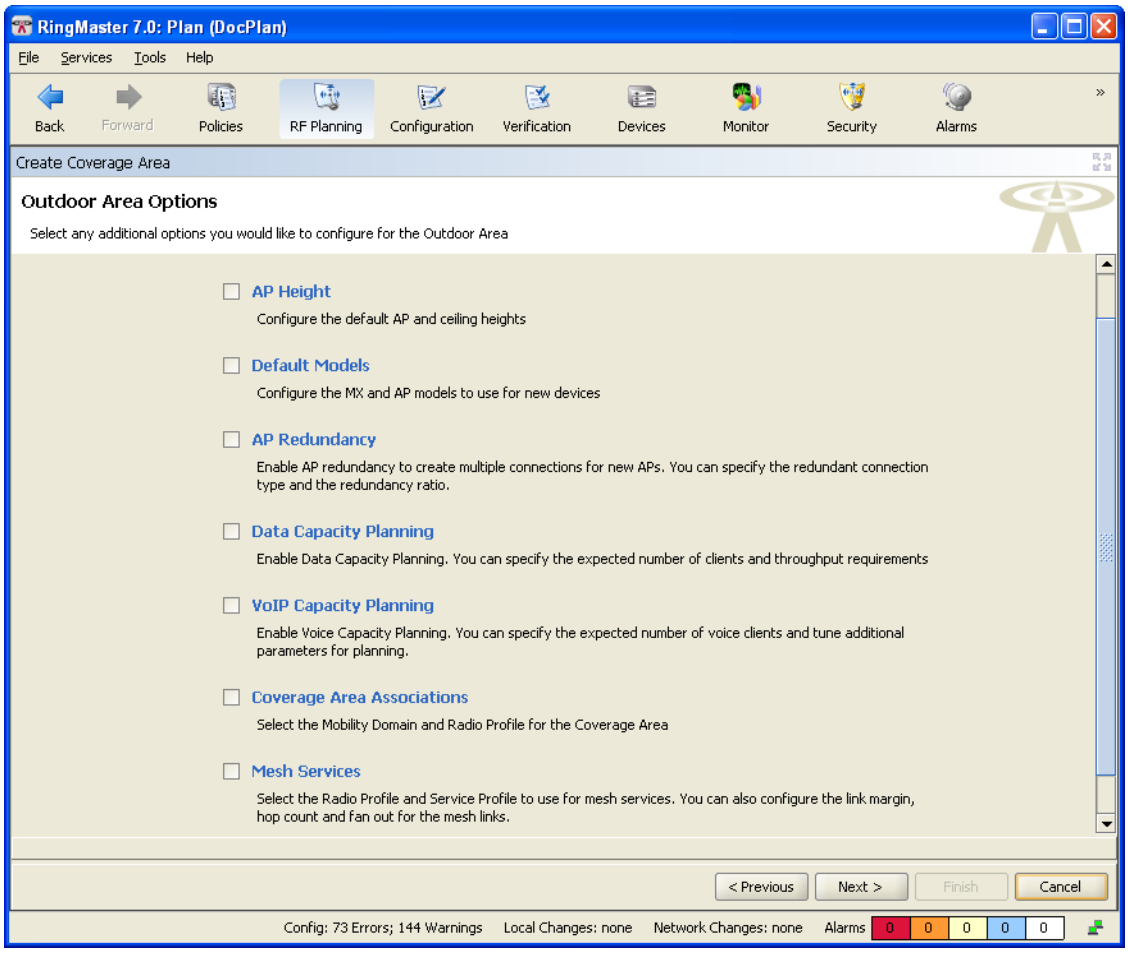
11. This dialog allows you to perform optional coverage area functions. Select a checkbox and click **Next,** select nothing and click **Next** to continue with the wizard**,** or select **Cancel** to exit the wizard.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security Alarms
Create Coverage Area
Outdoor Area Options
Select any additional options you would like to configure for the Outdoor Area
AP Height
Configure the default AP and ceiling heights
Default Models
Configure the MX and AP models to use for new devices
AP Redundancy
Enable AP redundancy to create multiple connections for new APs. You can specify the redundant connection type and the redundancy ratio.
Data Capacity Planning
Enable Data Capacity Planning. You can specify the expected number of clients and throughput requirements
VoIP Capacity Planning
Enable Voice Capacity Planning. You can specify the expected number of voice clients and tune additional parameters for planning.
Coverage Area Associations
Select the Mobility Domain and Radio Profile for the Coverage Area
Mesh Services
Select the Radio Profile and Service Profile to use for mesh services. You can also configure the link margin, hop count and fan out for the mesh links.
< Previous
Next >
Finish
Cancel
Config: 73 Errors; 144 Warnings
Local Changes: none
Network Changes: none
Alarms 0 0 0 0 0

Compute and Place for Mesh Access Points

Once a coverage area is defined, you determine optimal AP placement locations. *RingMaster* computes the number of outdoor APs required based on coverage or capacity planning algorithms for an Outdoor Area similar to outdoor-only (non-mesh) compute and place for mesh services. APs are placed in a coverage area at computed locations and the wizard prompts you to move them to appropriate locations and “lock” them.

The wizard allows you to select which of these APs are *Mesh Portals* (mesh portals having wired Ethernet backbone connectivity). Once you provide this information, the wizard prompts to plan for mesh APs and backhaul links. If at least 90% of the area is not covered, additional APs are placed on the area. You must identify enough mesh portals to provide wireless backhaul for remaining mesh APs. Mesh portals should be in the same coverage area. Link margin is used to determine the maximum distance between any two APs that require a mesh link.

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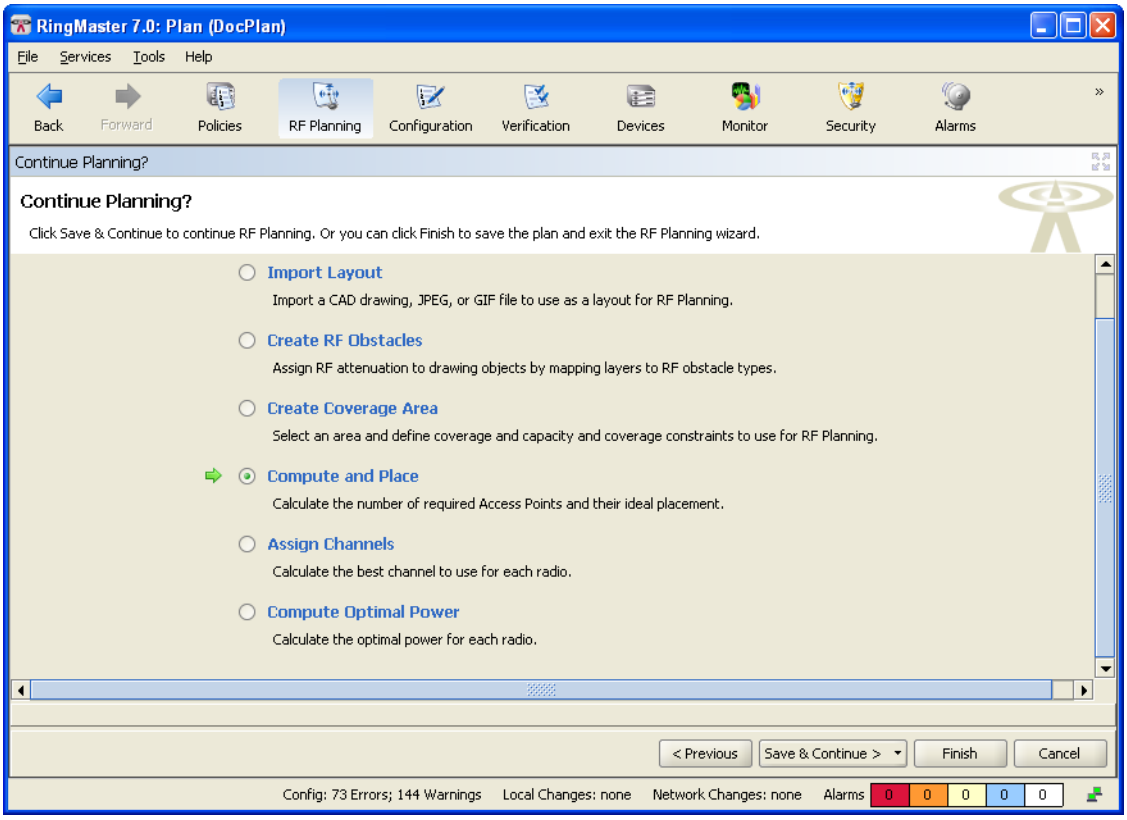
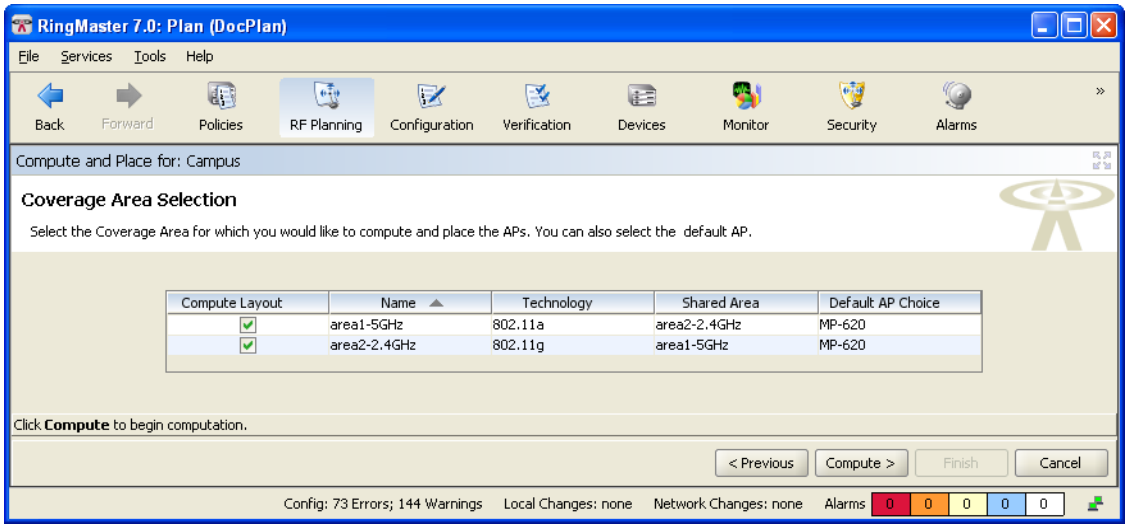
12. If you leave all “optional” checkboxes clear in step 11 and click **Next**, you see the **Continue Planning?** window with the **Compute and Place** checkbox selected.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security Alarms
Continue Planning?
Continue Planning?
Click Save & Continue to continue RF Planning. Or you can click Finish to save the plan and exit the RF Planning wizard.
Import Layout
Import a CAD drawing, JPEG, or GIF file to use as a layout for RF Planning.
Create RF Obstacles
Assign RF attenuation to drawing objects by mapping layers to RF obstacle types.
Create Coverage Area
Select an area and define coverage and capacity and coverage constraints to use for RF Planning.
Compute and Place
Calculate the number of required Access Points and their ideal placement.
Assign Channels
Calculate the best channel to use for each radio.
Compute Optimal Power
Calculate the optimal power for each radio.
< Previous
Save & Continue >
Finish
Cancel
Config: 73 Errors; 144 Warnings
Local Changes: none
Network Changes: none
Alarms 0 0 0 0 0

Click **Save and Continue** to proceed with the wizard.

13. You see the dialog below. Click the checkbox of areas for which you want computation and click **Compute**.



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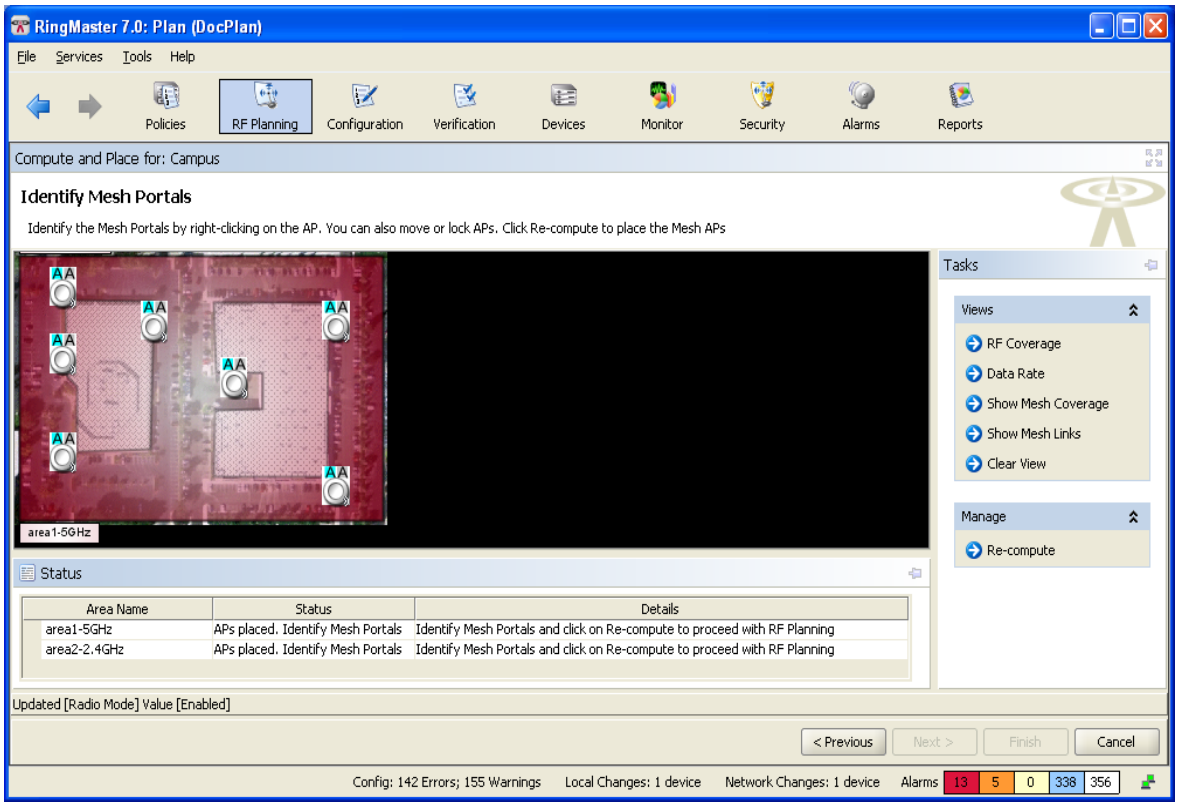
14. You see the **Identify Mesh Portals** window. Right-click on APs that will serve as Mesh APs and identify them as such. Click **Re-compute**.



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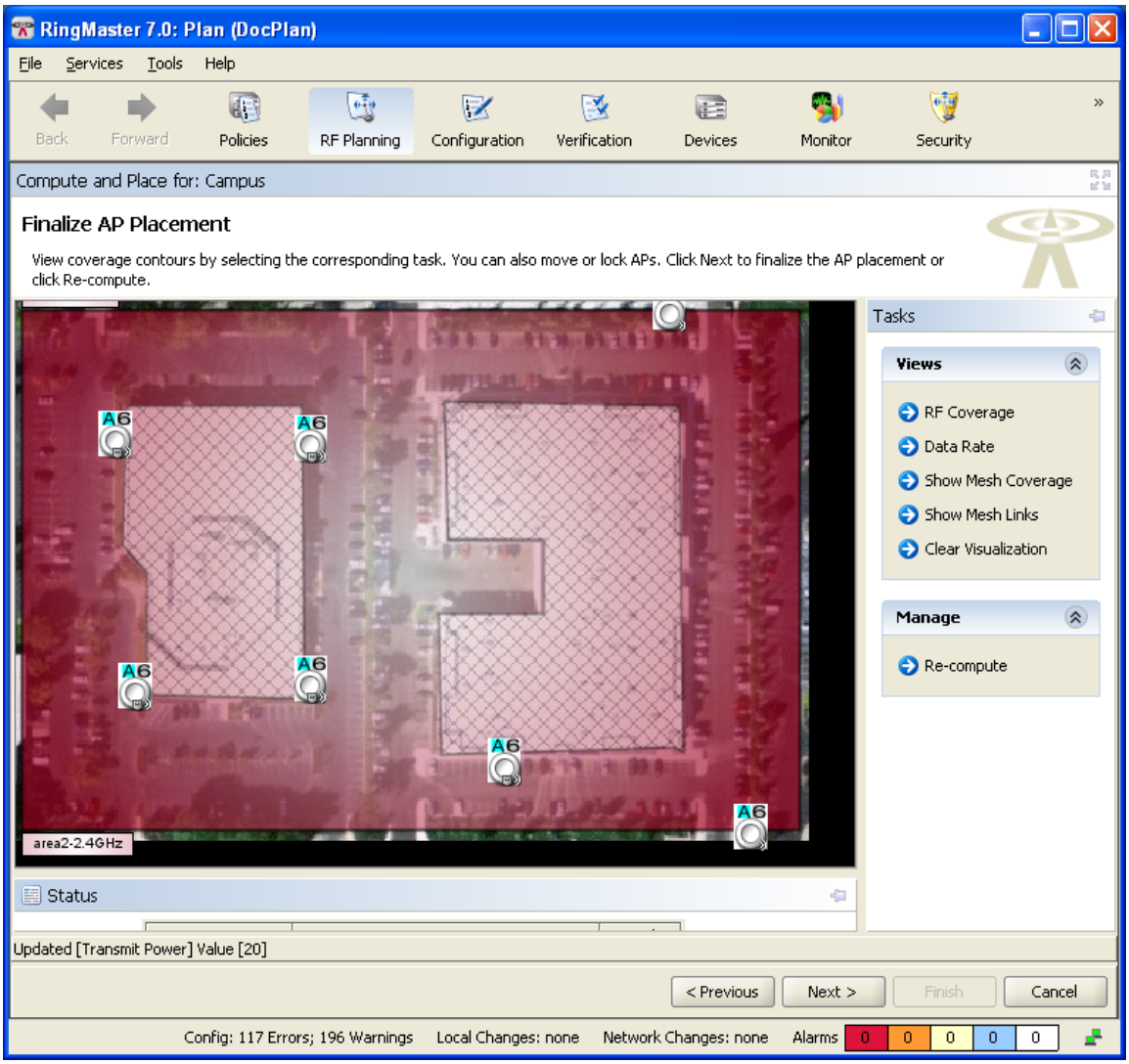
15. You see the **Finalize AP Placement** window. Move APs to desired locations and click **Next**.



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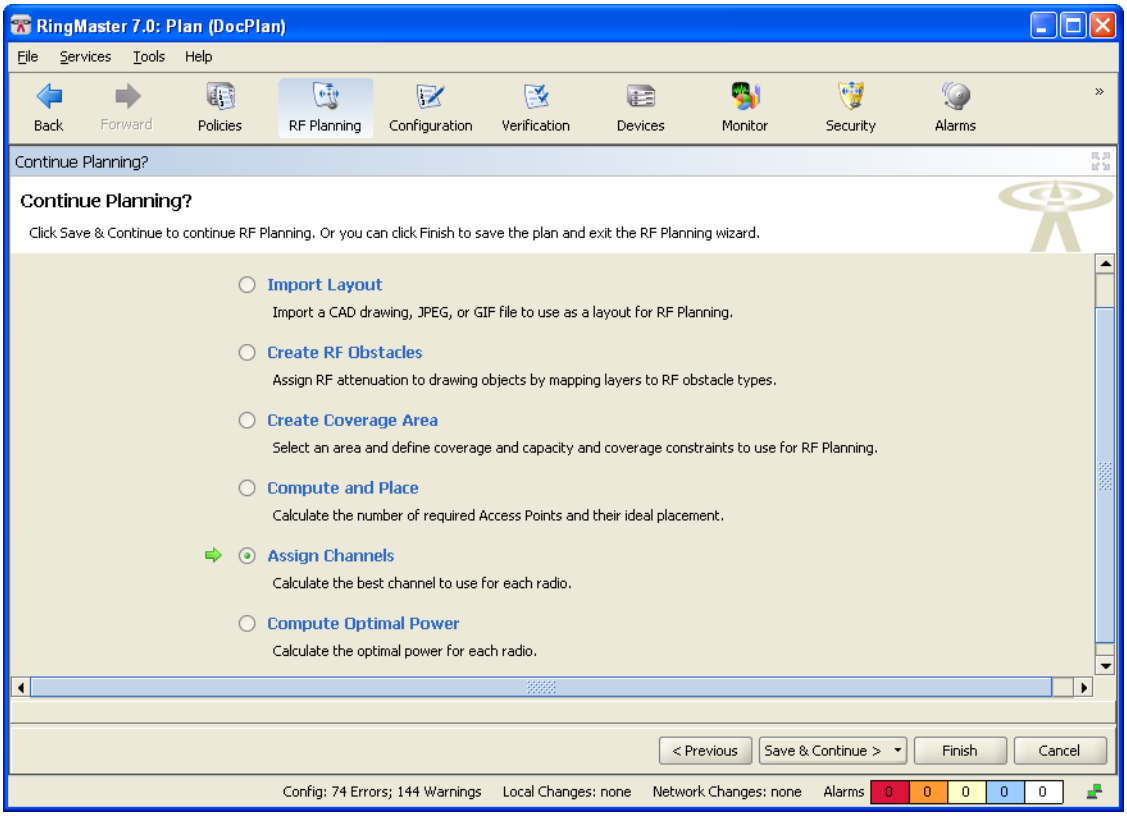
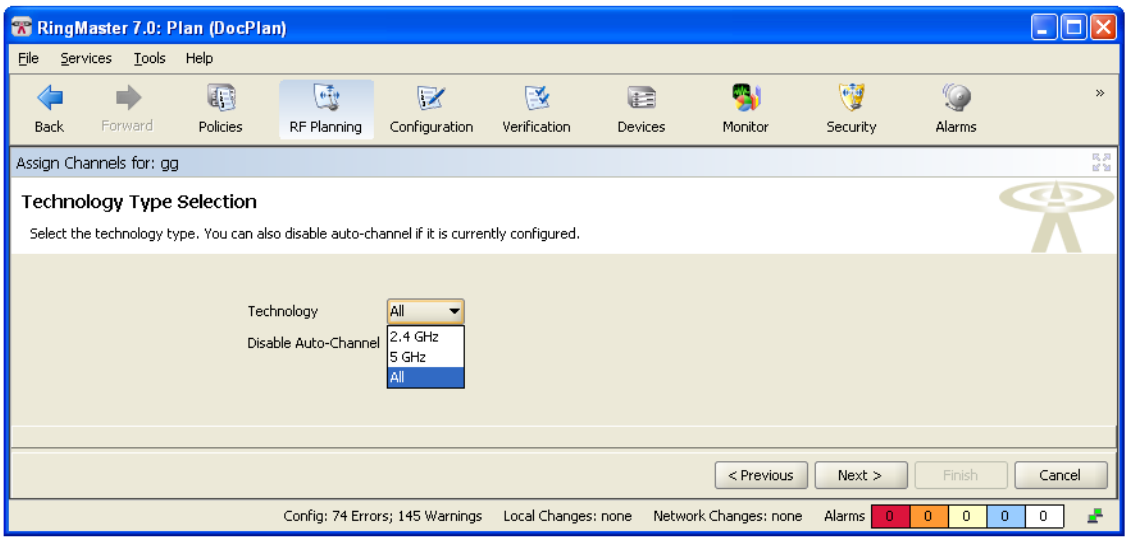
16. You once again see the **Continue Planning?** dialog.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security Alarms
Continue Planning?
Continue Planning?
Click Save & Continue to continue RF Planning. Or you can click Finish to save the plan and exit the RF Planning wizard.
Import Layout
Import a CAD drawing, JPEG, or GIF file to use as a layout for RF Planning.
Create RF Obstacles
Assign RF attenuation to drawing objects by mapping layers to RF obstacle types.
Create Coverage Area
Select an area and define coverage and capacity and coverage constraints to use for RF Planning.
Compute and Place
Calculate the number of required Access Points and their ideal placement.
Assign Channels
Calculate the best channel to use for each radio.
Compute Optimal Power
Calculate the optimal power for each radio.
< Previous
Save & Continue >
Finish
Cancel
Config: 74 Errors; 144 Warnings
Local Changes: none
Network Changes: none
Alarms

Click **Save and Continue** to continue planning or **Finish** to save settings and exit.

17. If you clicked **Save and Continue**, you see the **Technology Type Selection** dialog:



Select a **Technology** and select or clear to **Disable Auto-Channel**. Click **Next**.

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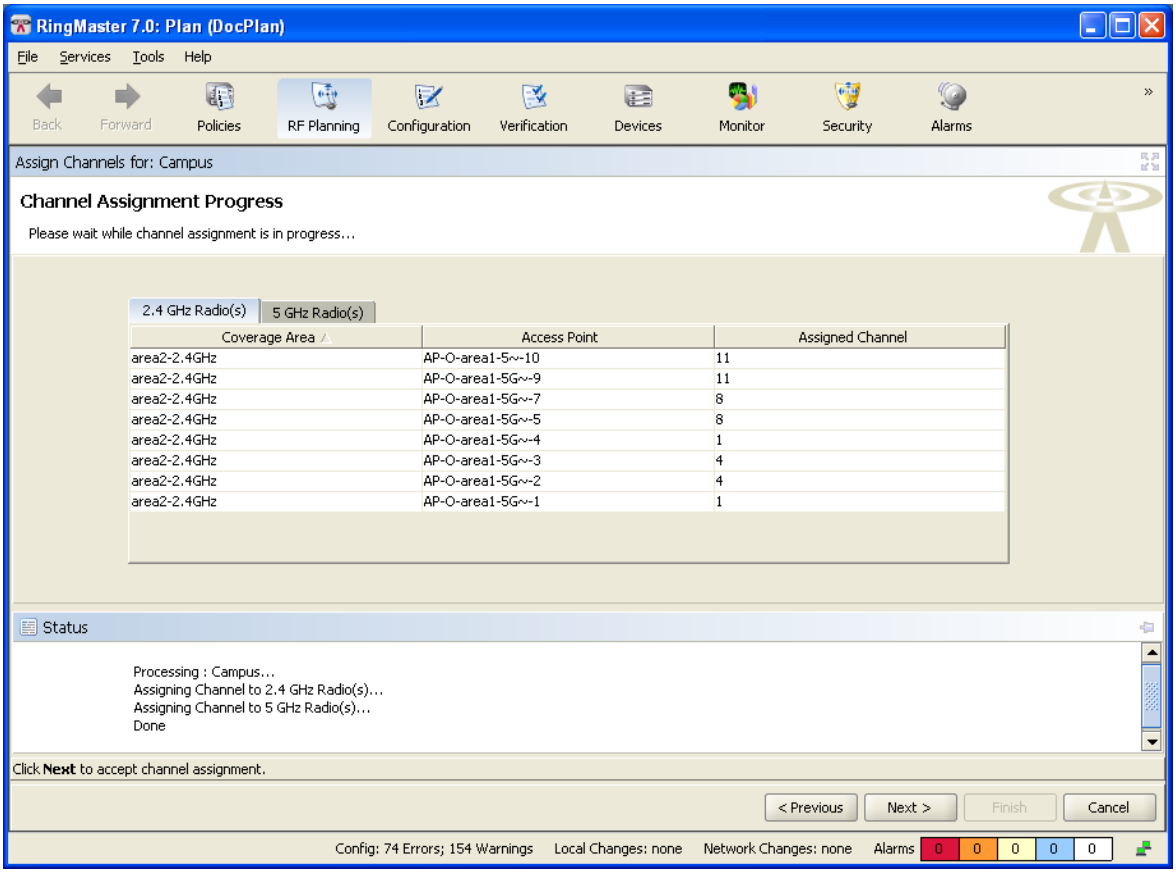
18. You will be asked to wait while channel assignment is in progress. When assignment is complete, the Status area will show **Done**. Click **Next**.



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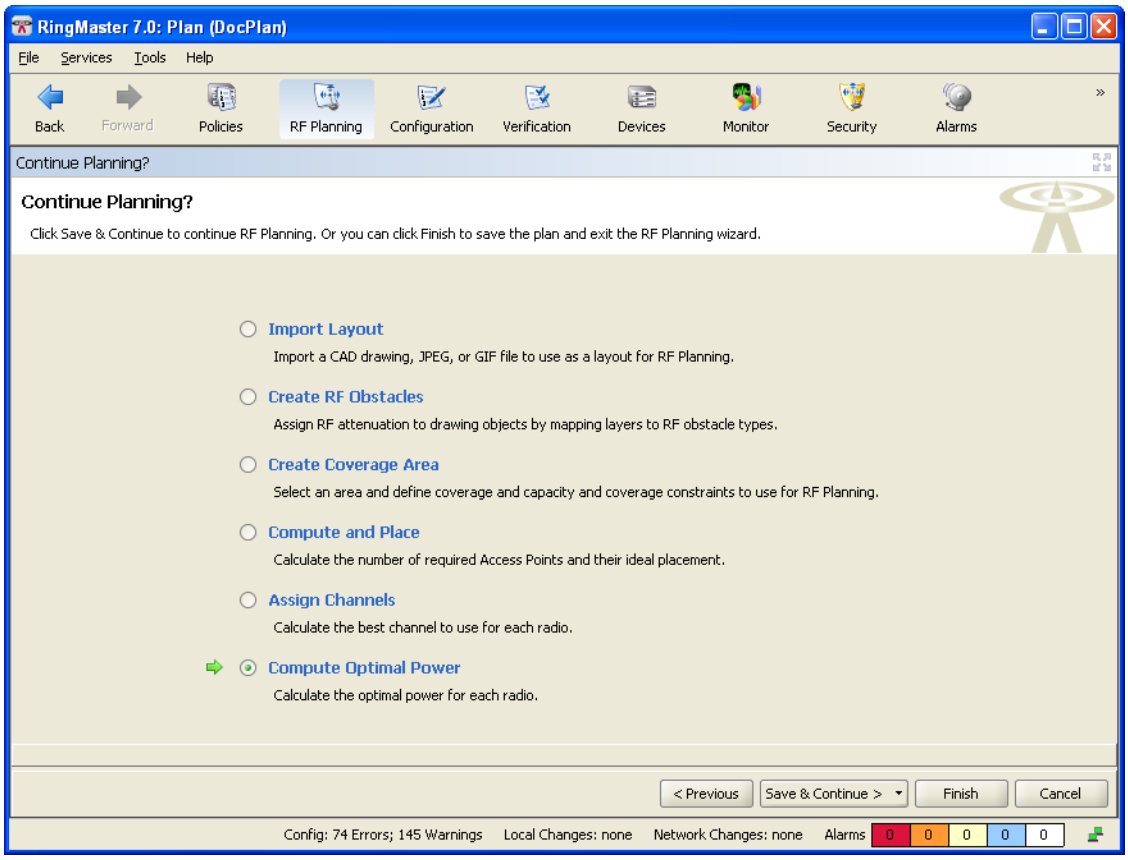
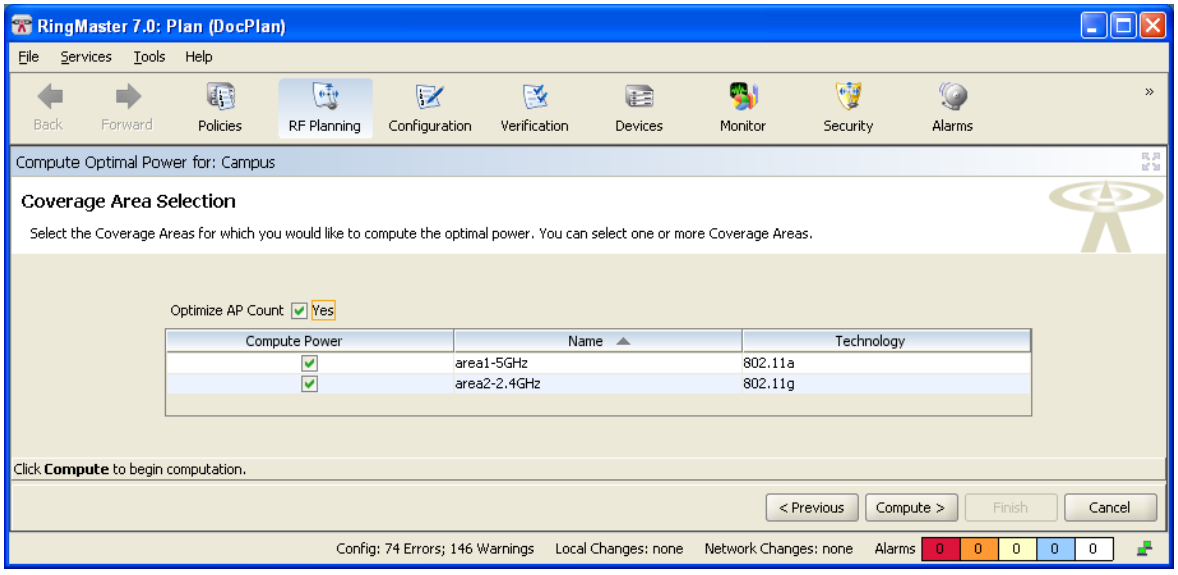
19. You now see the **Continue Planning?** window with **Compute Optimal Power** selected.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security Alarms
Continue Planning?
Continue Planning?
Click Save & Continue to continue RF Planning. Or you can click Finish to save the plan and exit the RF Planning wizard.
Import Layout
Import a CAD drawing, JPEG, or GIF file to use as a layout for RF Planning.
Create RF Obstacles
Assign RF attenuation to drawing objects by mapping layers to RF obstacle types.
Create Coverage Area
Select an area and define coverage and capacity and coverage constraints to use for RF Planning.
Compute and Place
Calculate the number of required Access Points and their ideal placement.
Assign Channels
Calculate the best channel to use for each radio.
Compute Optimal Power
Calculate the optimal power for each radio.
< Previous
Save & Continue >
Finish
Cancel
Config: 74 Errors; 145 Warnings
Local Changes: none
Network Changes: none
Alarms

Click **Save and Continue** to proceed with the wizard.

20. You see the **Coverage Area Selection** window.



Click the checkbox if you wish to **Optimize AP Count**. Click checkboxes for areas you want to compute optimal power for, and click **Compute**.

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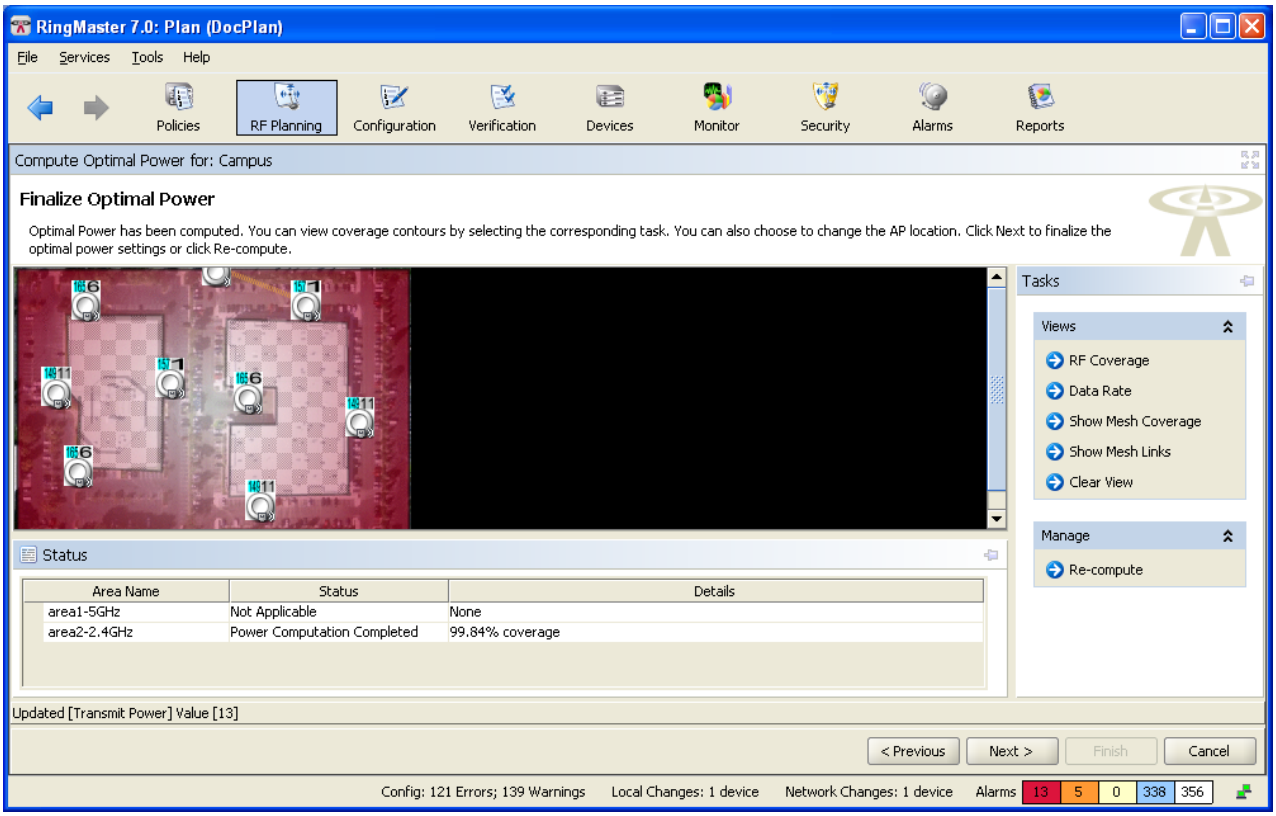
21. The **Finalize Optimal Power** dialog allows you visualize data rates and other items. The illustration below shows **Data Rate** for a simple example. Click **Next** when done.



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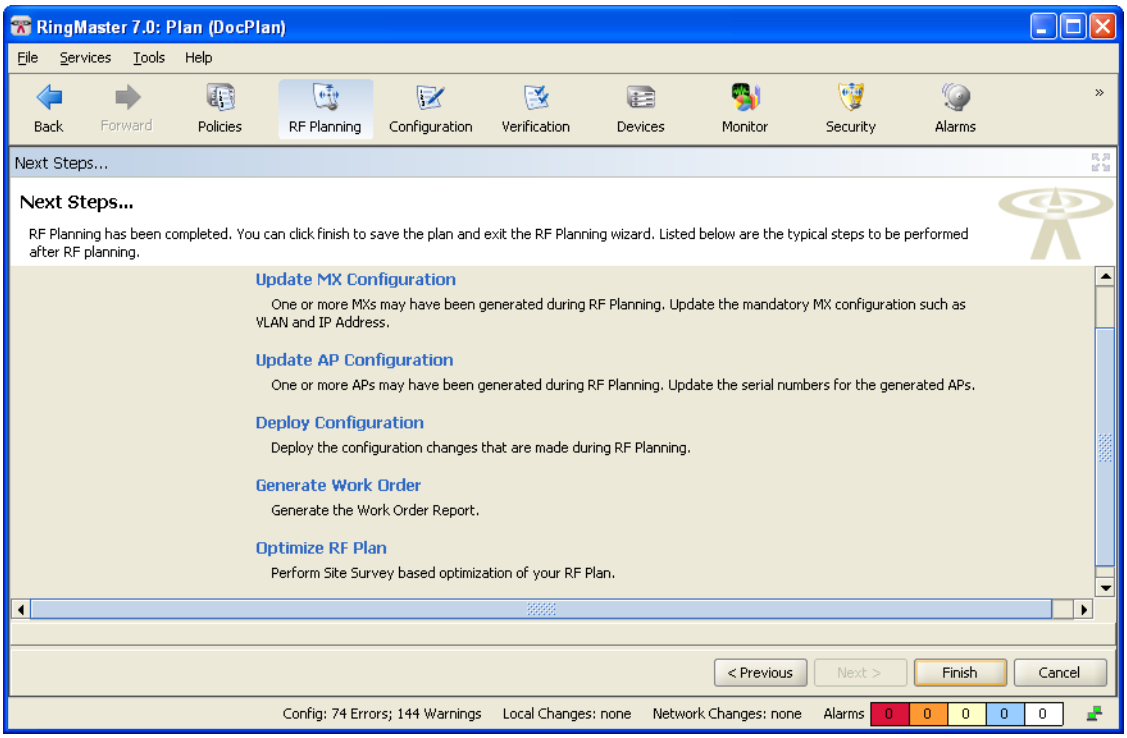
22. A window indicating that RF Planning wizard is done and suggesting next steps you might wish to perform is displayed. Click **Finish** after reading this.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security Alarms
Next Steps...
Next Steps...
RF Planning has been completed. You can click finish to save the plan and exit the RF Planning wizard. Listed below are the typical steps to be performed after RF planning.
Update MX Configuration
One or more MXs may have been generated during RF Planning. Update the mandatory MX configuration such as VLAN and IP Address.
Update AP Configuration
One or more APs may have been generated during RF Planning. Update the serial numbers for the generated APs.
Deploy Configuration
Deploy the configuration changes that are made during RF Planning.
Generate Work Order
Generate the Work Order Report.
Optimize RF Plan
Perform Site Survey based optimization of your RF Plan.
< Previous Next > Finish Cancel
Config: 74 Errors; 144 Warnings Local Changes: none Network Changes: none Alarms 0 0 0 0 0

Mesh AP Channel Assignment and Optimal Power Computation

Channel assignment for a backhaul link is not required. Only mesh portals are assigned channels. Mesh APs must have enough transmit power so a backhaul link can be established with mesh portal(s). Mesh portals that connect to mesh APs must have enough transmit power so a backhaul link can be established.

Mesh Visualization and Adaptable Configuration

A **Mesh Planning** wizard is available for Mesh Link visualization. You can select two APs and visualize the RF coverage for APs in a vertical configuration. You can also see RF coverage range and adjust parameters to increase or decrease RF coverage range for a radio.

You can adjust the following parameters:

- **Coverage Area**
  - Data Rate
  - Environment type
  - Link Margin
- **Radio attributes**
  - Channel Numbers
  - Transmit Power
  - Antenna Type
  - Antenna Tilt
  - Cable Loss
  - Radio Height

After planning a mesh network, click on the **Modify Mesh Link** task. This will bring up a dialog allowing you to adjust mesh links. Click on two APs (Shift + Click) that are the two ends of a mesh link and click **Next**. You will see a visualization dialog similar to the one shown below. You can adjust properties

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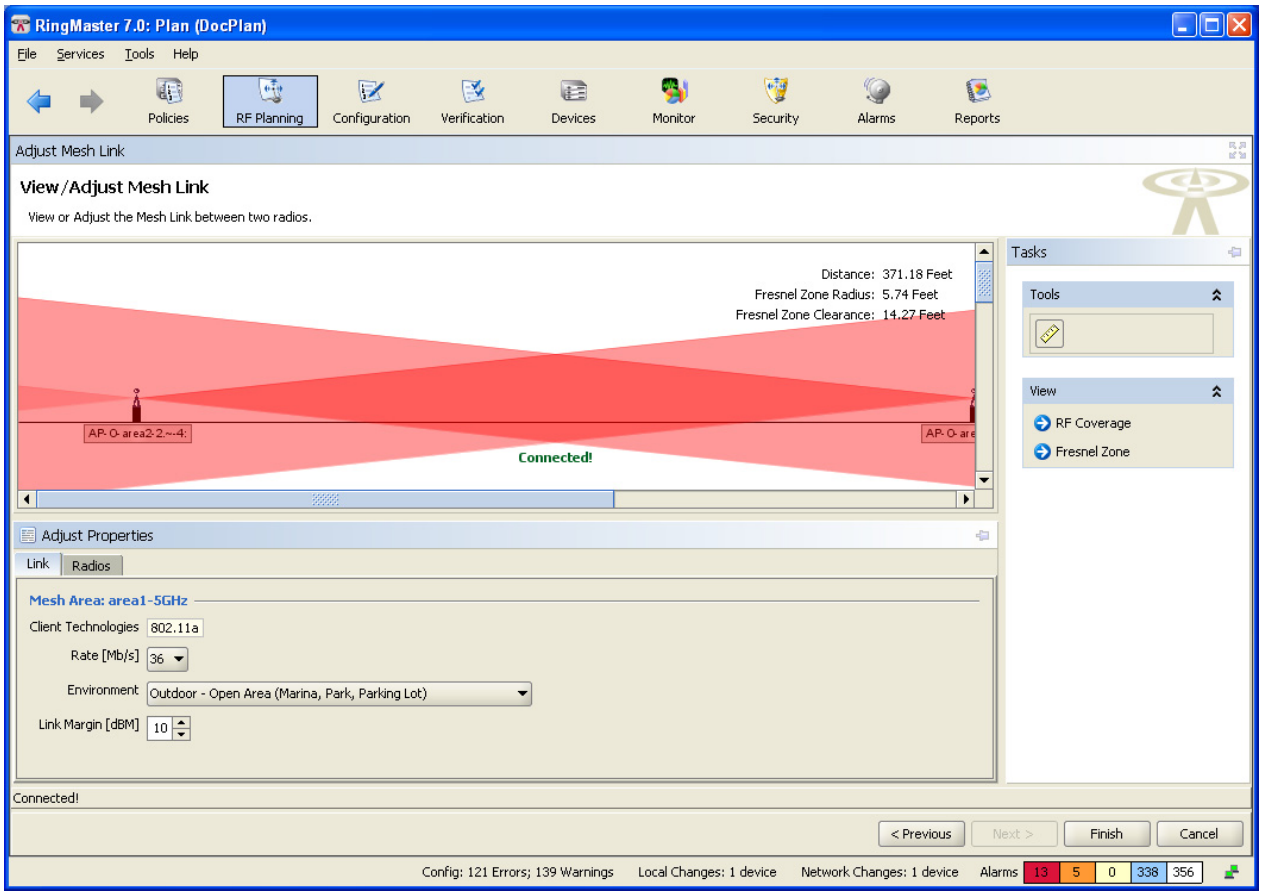
using the Link and/or Radios tabs. By visualizing the range of RF coverage, you can adjust parameters to increase/decrease RF coverage on a radio.

The **Link** tab allows you to change settings for link margin as well as rate and environment type.



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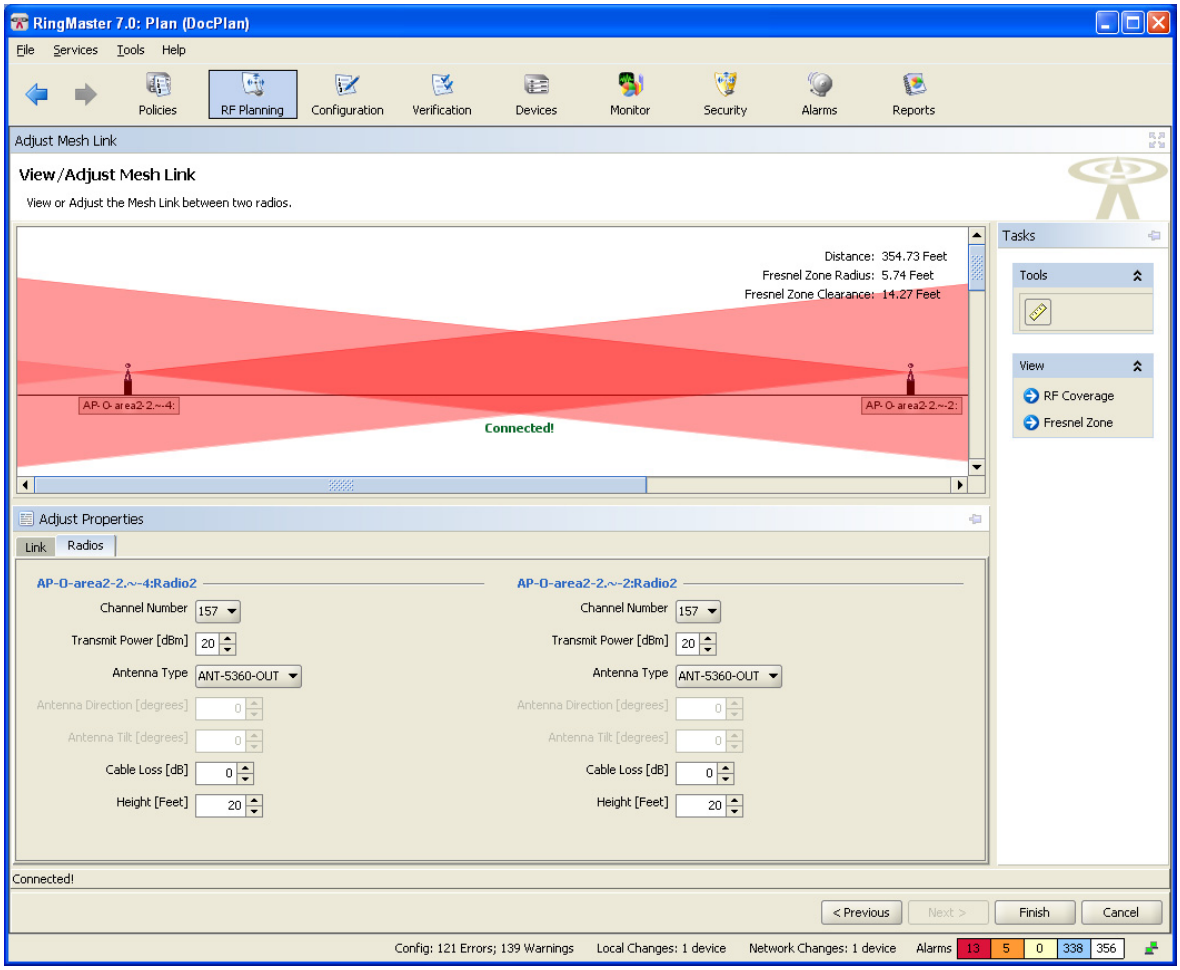
The **Radios** tab allows you to change settings for antenna direction, transmit power, and antenna type. For RF Planning with external antennas there are additional configurable factors that require further consideration:



- **Channel Number —** Assigned channel of radio
- **Transmit Power [dBm] —** Assigned power for radio
- **Antenna Type —** Pull-down for selection of internal or external antenna type
- **Antenna Direction [degrees] —** Direction of antenna aiming in degrees
- **Antenna Tilt [degrees]**— External antennas may be installed and configured to tilt, which results in a different coverage contour. Using the **Modify Mesh Link** wizard, you can adjust tilt and visualize resulting coverage contours. This parameter is available for each radio used in a mesh link. The default is 0 (pointing up) and the range is -30 to 30 (in direction of the beam).
- **Cable Loss [dB]** — Depending on the location of an external antenna, a cable may be required to connect the antenna to the AP. Adding a cable introduces losses which must be accounted for when drawing coverage contours as well as the mesh link. Default cable loss is 0 dB [meaning no cable loss is present] and the range is 0 to 20 dB. This parameter is settable for each mesh radio.
- **Height [Feet]** — Height of antenna in feet

When selections have been made, click **Finish**.

Fresnel Zone Visualization

The wizard allows you to visualize the Fresnel zone for a mesh link. Free space loss requires an path to be optically clear and have a clear Fresnel zone surrounding it. If a link can't be established between

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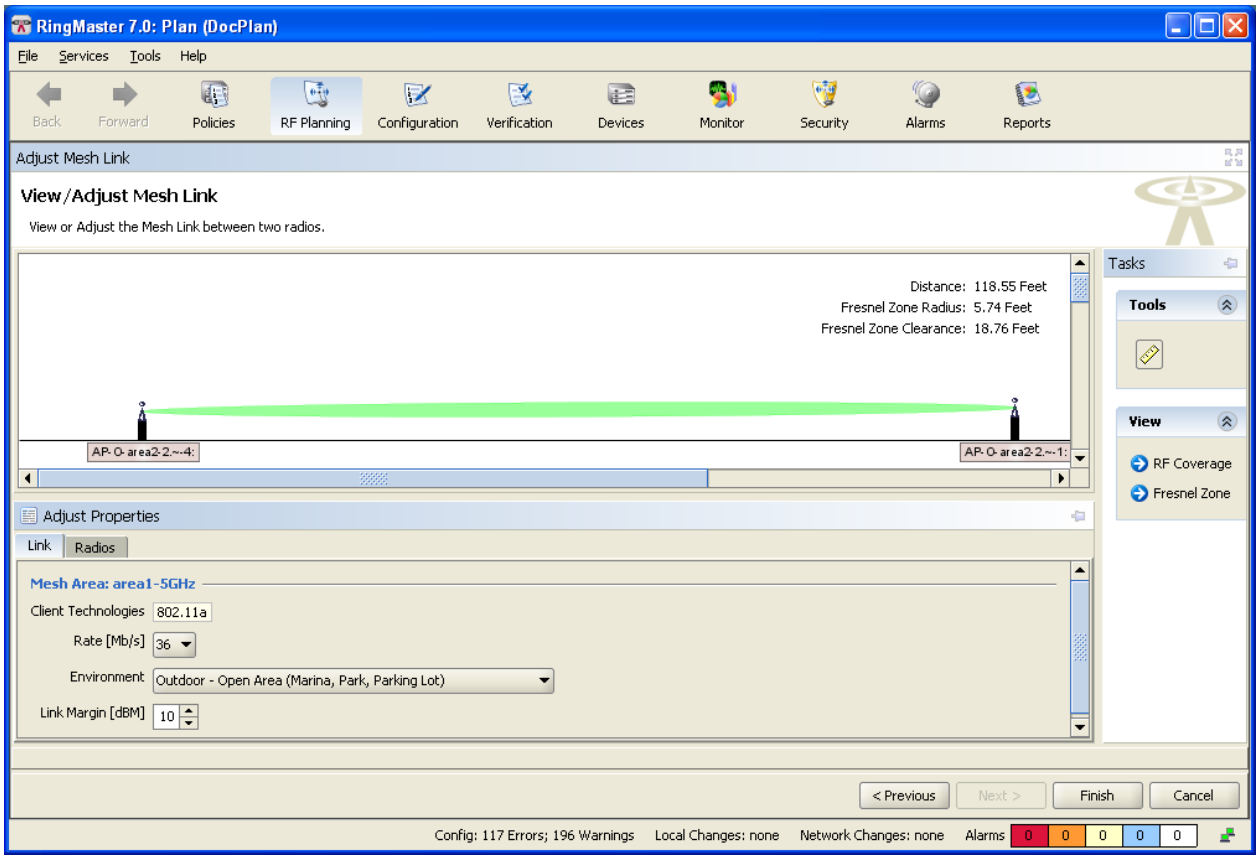
two APs, you use this wizard to model different scenarios and adjust key inputs — for example, antenna type, height, tilt, etc. — to view corresponding effects. Visualizing the Fresnel zone is important because objects in the Fresnel zone cause reflection which in turn causes multipath distortion. Fresnel zone incursions can lead to substantial degradation of RF signals at the receiver.

From the **View/Adjust Mesh Link** window **Link** tab, you see the following for Fresnel Zone:



For details on configuring Mesh services, refer to the publication *RingMaster 7.4 Configuration Guide*.

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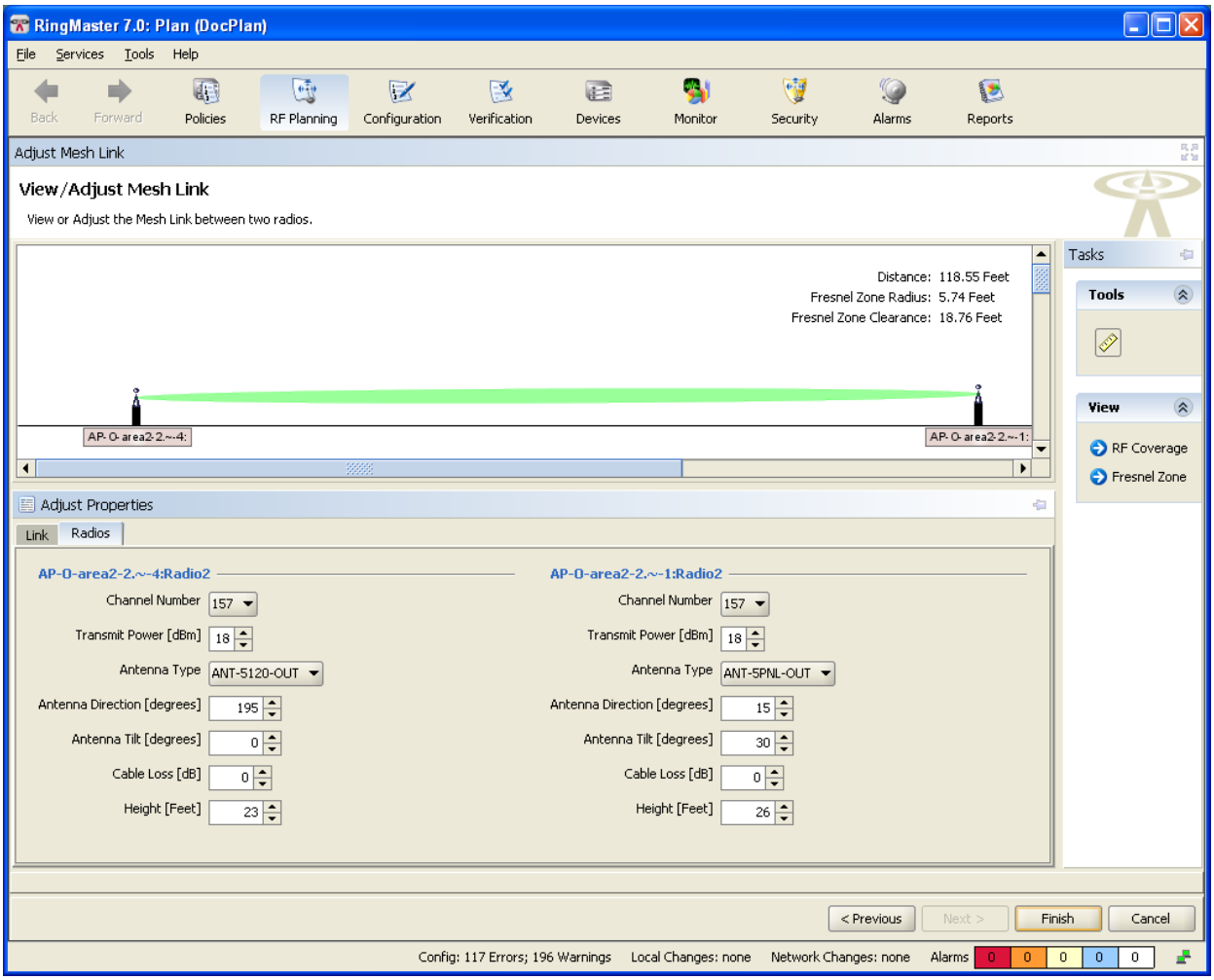
From the **View/Adjust Mesh Link** window **Radios** tab, you see the following:



Optional Processes

Mesh AP Boot Configuration

You can set up the boot configuration for any AP, including a Mesh AP.

To do this, the procedure is as follows:

1. Click on the **Configuration** button on the Navigation Bar.
2. Click on the plus sign adjacent an MX and select **Access Points** in the **Organizer** panel.
3. Select an AP in the table in the **Content** panel and then click **AP Boot Configuration** in the **Tasks** panel.

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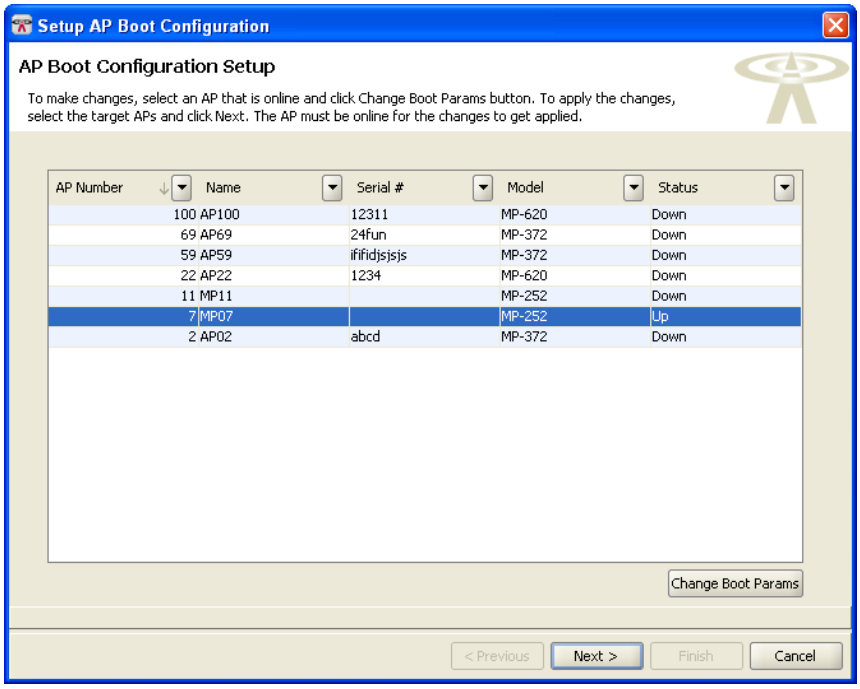
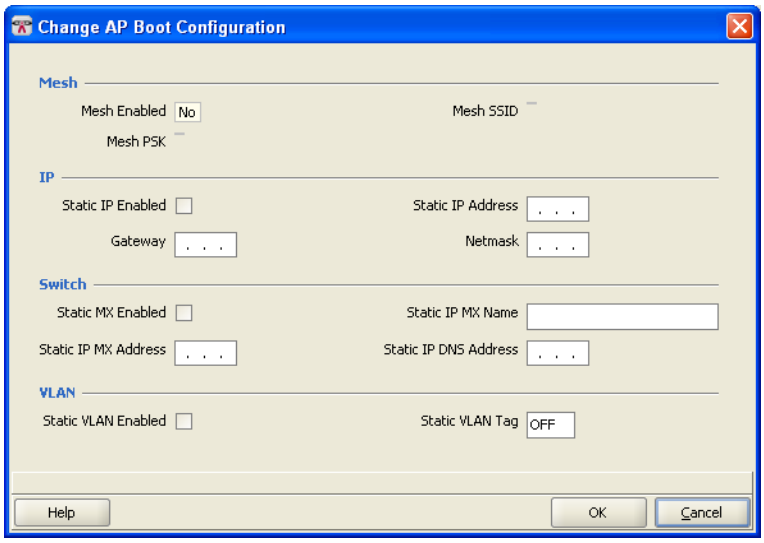
4. The dialog below appears.


Setup AP Boot Configuration
AP Boot Configuration Setup
To make changes, select an AP that is online and click Change Boot Params button. To apply the changes, select the target APs and click Next. The AP must be online for the changes to get applied.
AP Number
Name
Serial #
Model
Status
100 AP100 12311 MP-620 Down
69 AP69 24fun MP-372 Down
59 AP59 ififidjsjsjs MP-372 Down
22 AP22 1234 MP-620 Down
11 MP11 MP-252 Down
7 MP07 MP-252 Up
2 AP02 abcd MP-372 Down
Change Boot Params
< Previous
Next >
Finish
Cancel

5. One of the dialogs shown below appears. Enter appropriate values and then click **OK**.



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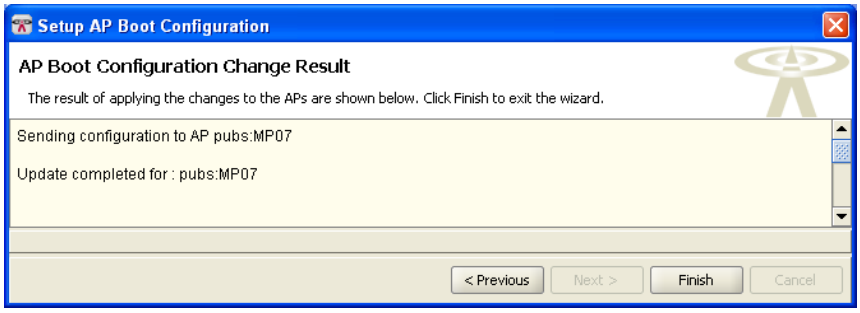
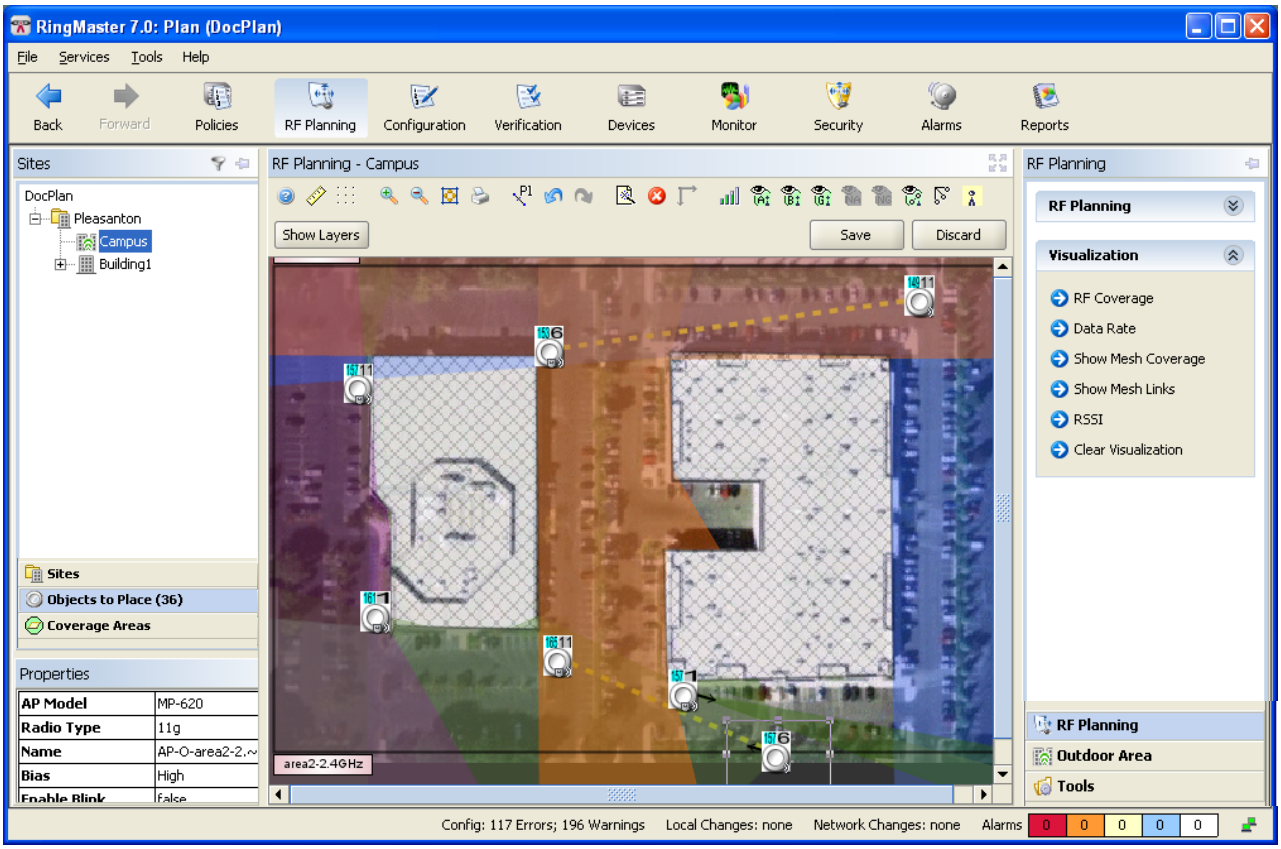
6. You are returned to the previous dialog where you click Next and you will see a dialog that tells you the AP Boot changes are being applied. Click **Finish** to exit the wizard.


Setup AP Boot Configuration
AP Boot Configuration Change Result
The result of applying the changes to the APs are shown below. Click Finish to exit the wizard.
Sending configuration to AP pubs:MP07
Update completed for : pubs:MP07
< Previous
Next >
Finish
Cancel

Visualization Tools

You can click on **Visualization** tools to **Show Mesh Links** and to **Show Mesh Coverage** as shown in the example below:



Editing Multiple Outdoor Areas

The preferred manner of adding Outdoor Areas by using the **Create Outdoor Area** item in the **Tasks** panel after selecting a site in the **Organizer** panel. The alternate method described in this section achieves the same result.

When you add a site, you can specify zero or more Outdoor Areas. You can edit outside areas later as follows: The **Organizer** panel shows Outdoor Areas you specified when adding the site.

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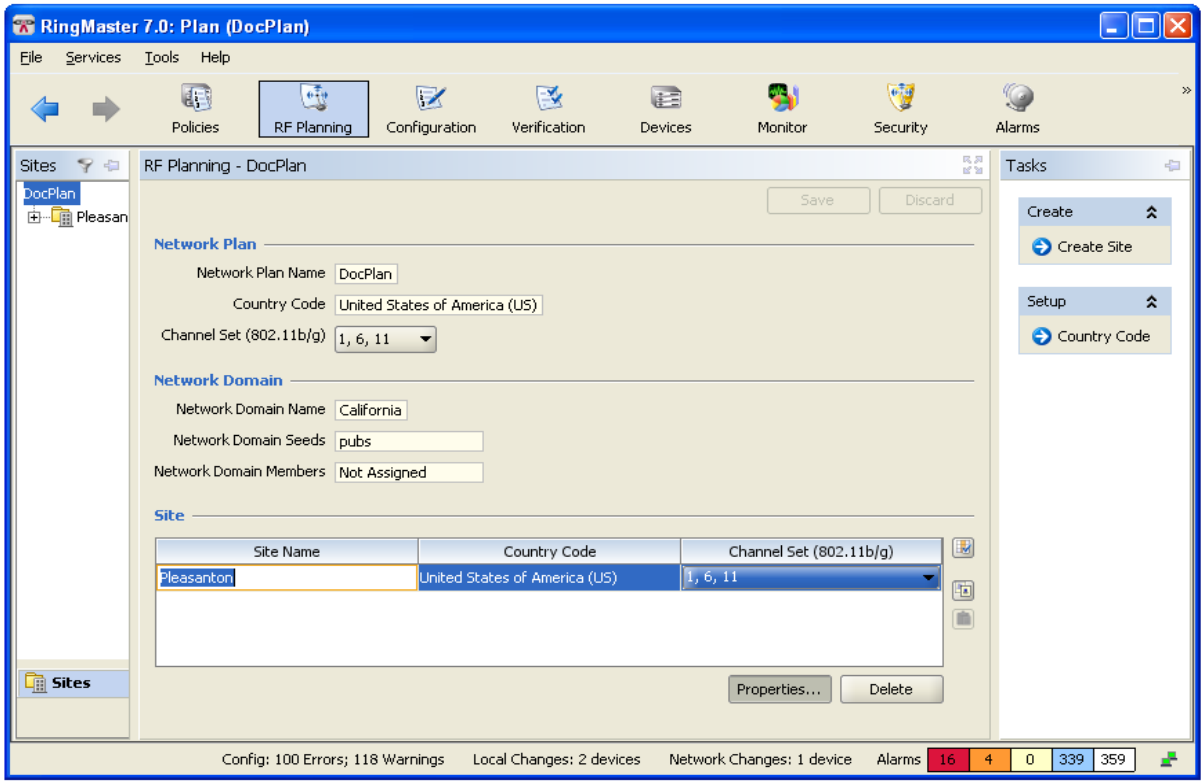
You can edit Outdoor Areas later as follows:

1. Click on the **Plan** name in the **Organizer** panel, then in the **Content** panel click a **Site Name**, then click **Properties...**.



The **Organizer** panel shows buildings, floors, and Outdoor Areas that were specified when the site was added.

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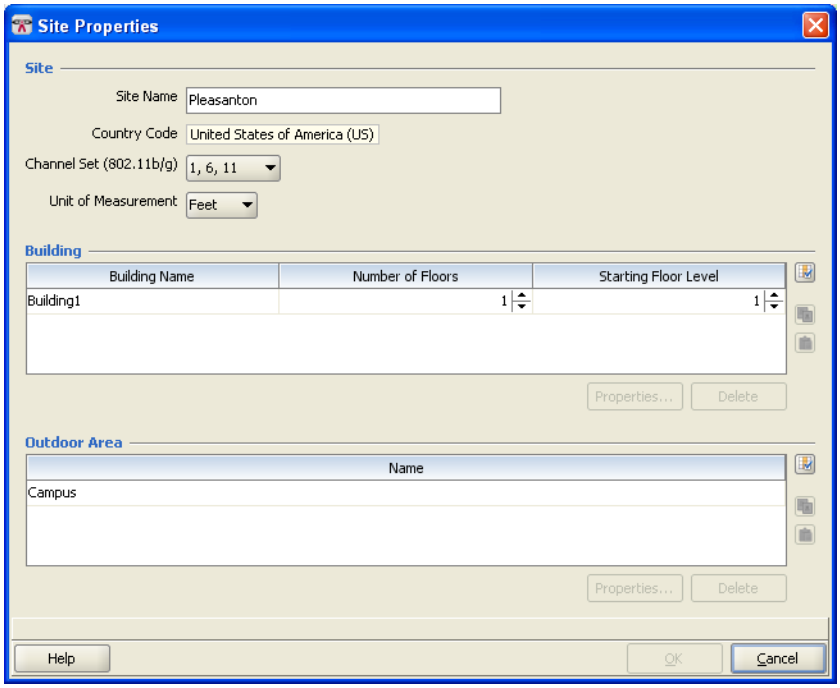
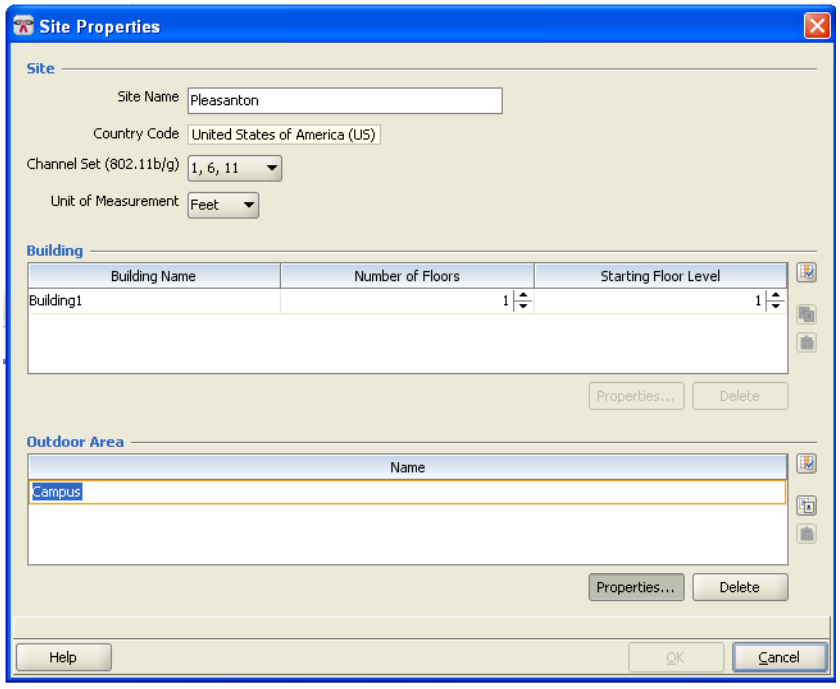
2. The **Site Properties** dialog box prompts you for information about both buildings and Outdoor Areas.



3. Select an Outdoor Area and click **Properties....**.



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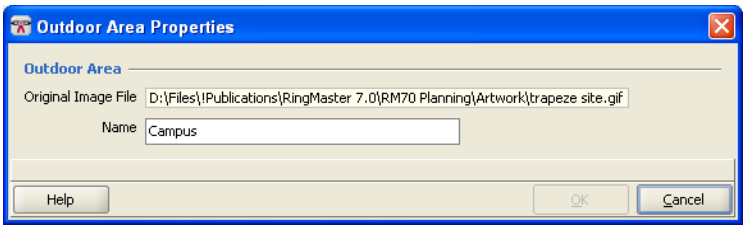
4. In the **Outdoor Area Properties** dialog, the original image file attribute is read-only on this dialog. To change it, re-run the **Import Layout** wizard**,** then click **OK**.



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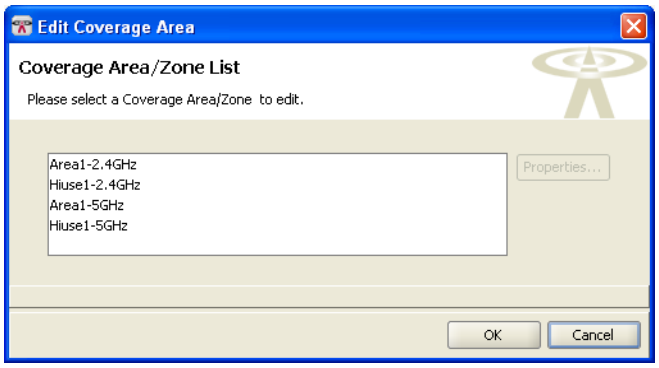
Coverage and Capacity Planning

This chapter describes methods for planning coverage areas and determining data handling requirements and capacities in these areas.

Editing Coverage Areas

To edit existing coverage areas:

1. Display a floor plan in the **Content** panel.
2. In the **Tasks** panel, click **Floor**.
3. Under **Edit Floor**, click **Areas**. The **Coverage Area/Zone List** dialog is displayed.



4. Select a coverage area you want to edit and click **Properties**. The **Coverage Area Properties** dialog for the selected coverage area appears.

You can also display the **Properties** dialog by displaying a floor plan, selecting **Coverage Areas** in the **Organizer** panel, then right-clicking (Macintosh: Control+click) on a coverage area and selecting **Edit Properties** from the pull-down menu.

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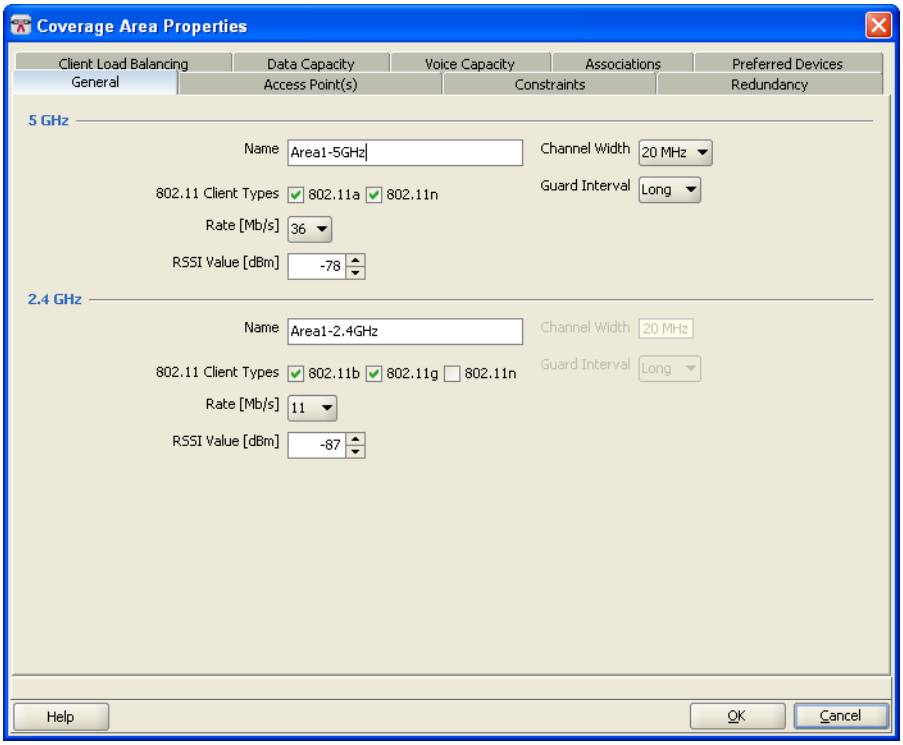

General Tab

Under the **General** tab for 5 GHz and 2.4 GHz technologies, you can do the following:

1. In the **Name** field, edit the name of the coverage area (1 to 60 characters long, with no tabs).
2. From the **802.11 Client Types**, select 802.11a, 802.11b, 802.11g or 802.11n or several
3. In the **Rate [Mb/s]** lists for 5 GHz and 2.4 GHz technologies, select average desired association rates for clients in this coverage area.
4. In the **RSSI** pull-down for 5 GHz and 2.4 GHz technologies**,** select average value for clients in this coverage area.
5. Select a **Channel width** for 802.11n for 5 GHz.
6. Select a **Guard Interval** for 802.11n for 5 GHz and 2.4 GHz technologies.

Click **OK** to save settings and close the dialog.

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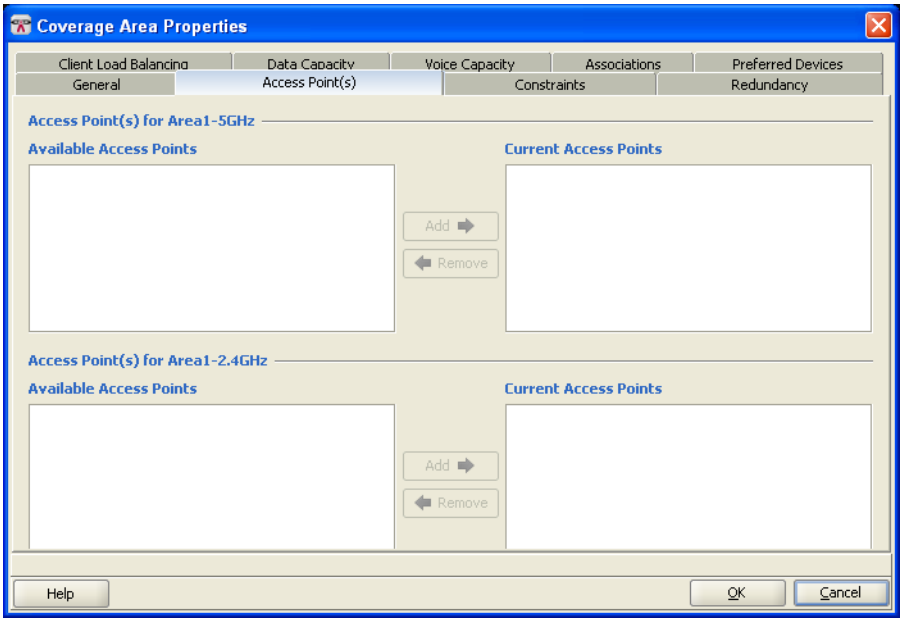
Access Points Tab

For both 5 GHz and 2.4 GHz, under the **Access Point(s)** tab, you can do the following:



1. Select **Available Access Points** in the list on the left for both **Access Point(s)** for both 5 GHz and 2.4 GHz, then click **Add** to make them **Current Access Points** in a network.
2. Access points can be removed using this dialog by selecting them in the right column and clicking on **Remove**.
3. Click **OK** to save settings and close the dialog.

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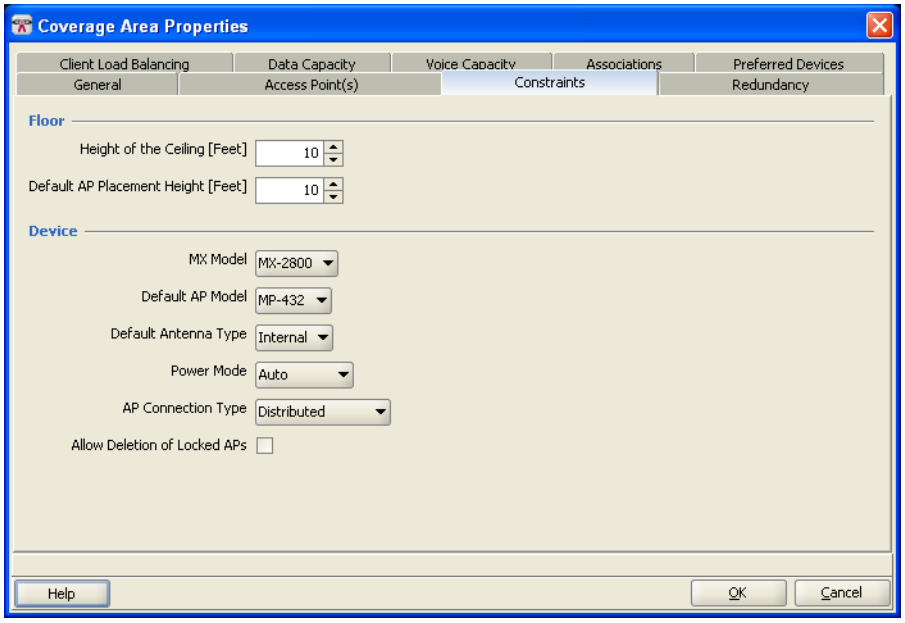
Constraints Tab

The **Constraints** tab has the following options:



1. To change the ceiling height, specify the new height in the **Height of the Ceiling** field.
2. To change the height where APs are mounted, specify the new mounting height with the **Default AP Placement Height** field.
3. To change the MX model, select a model from the **MX Model** list.
4. To change the default AP model, select a model from the **Default AP Model** list.
5. To change the AP connection type, select the type from the **AP Connection Type** list:
   - Distributed — APs can be indirectly attached through intermediate Layer 2 or Layer 3 devices.
   - Distributed (Auto) — APs can be indirectly attached through intermediate Layer 2 or Layer 3 devices. They receive configuration information automatically using a profile that assigns a Distributed AP number and name to the AP from among the unused valid AP numbers available on the switch. The profile also configures the AP with the AP and radio parameter settings in the profile.
6. To allow locked APs to be deleted when the **Compute and Place** function determines that they are no longer required, click on the **Allow Deletion of Locked APs** box. A locked AP is an AP that is already associated with the coverage area. For example, if you computed and placed APs in this coverage area on a previous occasion and you are now optimizing the plan, the APs are still associated with the coverage area.
7. Click **OK** to save settings and close the dialog.

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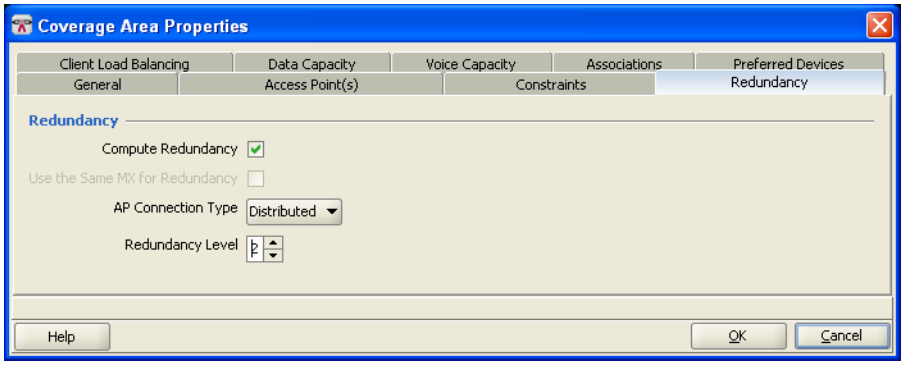
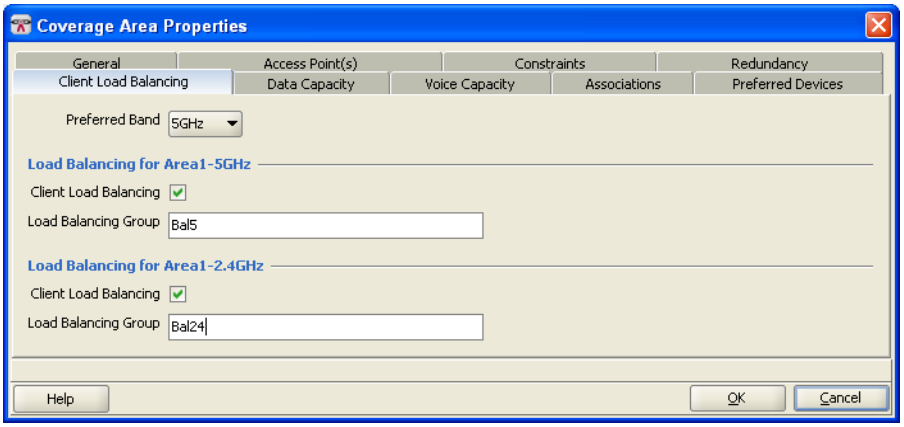
Redundancy Tab

The **Redundancy** tab has the following options:



1. To plan for redundant AP connections to MXs, Select **Compute Redundancy**.
2. To use the same MX for redundant connections, select **Use the Same MX for Redundancy**. This option places both of wired connections of an AP on the same MX switch. For optimal resiliency, use different MXs for redundancy.
3. For AP connection type for a redundant connection, **Distributed** is the only option on the **AP Connection Type** list.
4. To change the number of redundant connections for the distributed connection type, type the number in the **Redundancy Level** field. For direct connections, the redundancy level is always 1.
5. Click **OK** to save settings and close the dialog.

Client Load Balancing Tab



The **Client Load Balancing** tab has the following options:

1. Click the check box if you want to **Compute Redundancy**.
2. There is an option to **Use the Same MX for Redundancy**, which is disabled in the example.
3. Select **AP Connection Type** from the pull-down.
4. Select a **Redundancy Level**.

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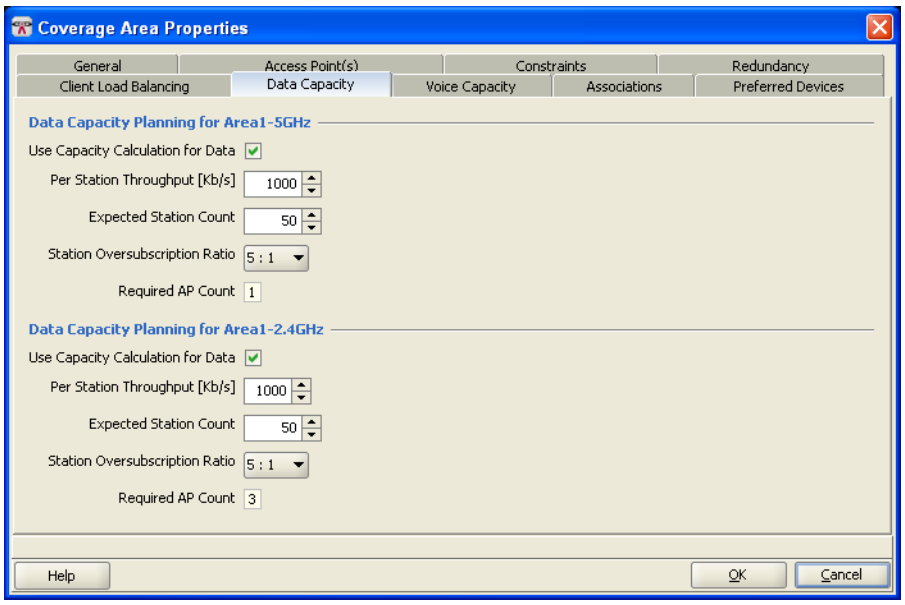
Data Capacity Tab

The **Data Capacity** tab has the following options:



For both 5 GHz and 2.4 GHz technologies, select the following:

1. To calculate AP placement and configuration based on coverage and on capacity for data, select **Use Capacity Calculation for Data**.
2. In the **Per Station Throughput [Kp/s]** list, specify throughput (combined transmit and receive) in kilobits per second (Kbps) for a station.
3. In the **Expected Station Count** list, specify the number of clients expected to be in the coverage area.
4. In the **Station Oversubscription Ratio** list, select the ratio for the average transmit behavior of the stations. The station oversubscription ratio is the ratio of active clients compared to total clients. For example, the ratio 5:1 indicates that, statistically, 20 percent of the clients are active at any given time.

   Click **OK** to save settings and close the dialog.

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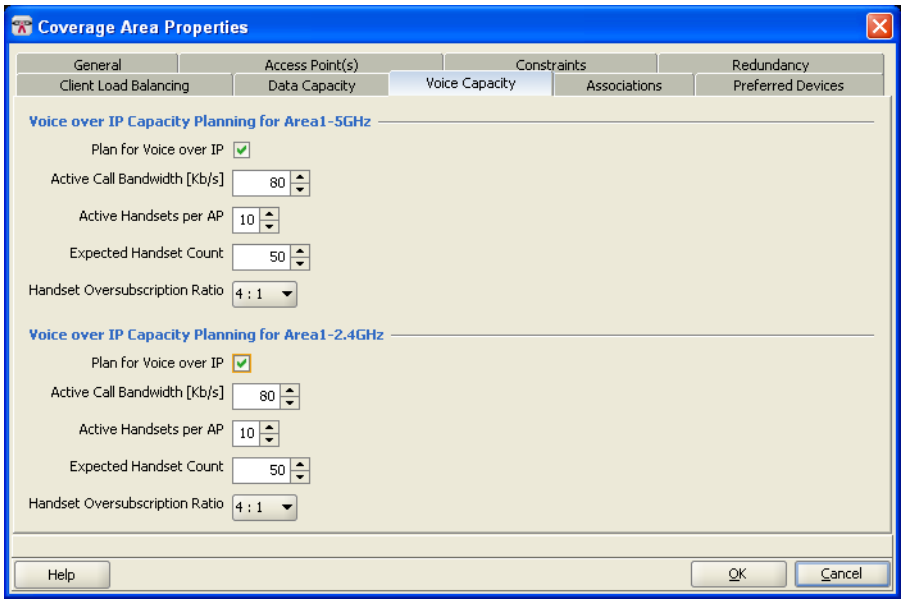
Voice Capacity Tab

The **Voice Capacity** tab has following options:



For both 5 GHz and 2.4 GHz technologies, select the following:

1. Click on **Plan for Voice over IP**.
2. From the **Active Call Bandwidth [Kb/s]** list, specify the amount of bandwidth in kilobits per second (Kbps) expected.
3. From the **Active Handsets per AP** list, specify the number of voice over IP phones per AP.
4. From the **Expected Handset Count** list, specify the number of voice over IP phones expected.
5. From the **Handset Oversubscription Ratio** list, select the ratio for the average transmit behavior of voice over IP phones. The handset oversubscription ratio is the ratio of active handsets compared to total handsets. For example, the ratio 4:1 indicates that, statistically, 25 percent of the voice over IP phones are active at any given time.

Click **OK** to save settings and close the dialog.

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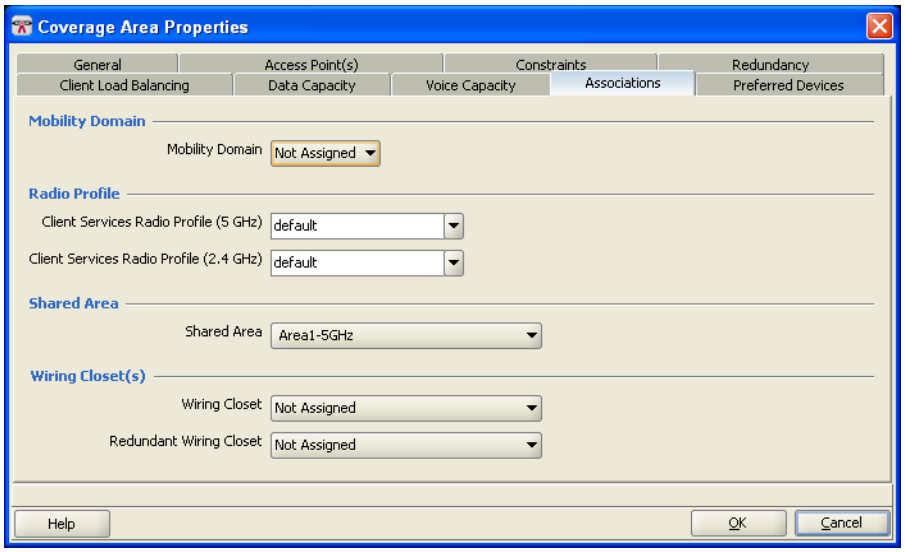
Associations Tab

The **Associations** tab has following options:



For both 5 GHz and 2.4 GHz:

1. From the **Mobility Domain** list, select the mobility domain with the APs used for this coverage area.
2. From the **Radio Profile** list, select a radio profile policy to be used for this coverage area. All radio profile policies configured in a network plan are listed. In addition, a **default** policy is listed. If you select **default**, the default radio profile settings are applied to the coverage area. (For information about policies, see “Configuring and Applying Policies,” in the publication *RingMaster 7.4 Configuration Guide*.)
3. From the **Shared Area** list, select a coverage area that shares APs with the one you are configuring. If you selected two radio technologies when defining the coverage area, a shared area is automatically created.
4. From the **Wiring Closet** list, select the wiring closet with the MX or switches to be connected to the shared APs.
5. From the **Redundant Wiring Closet** list, select the wiring closet that provides a redundant connection to the APs. This is required for directly connected APs; otherwise, this is not required.

Click **OK** to save settings and close the dialog.

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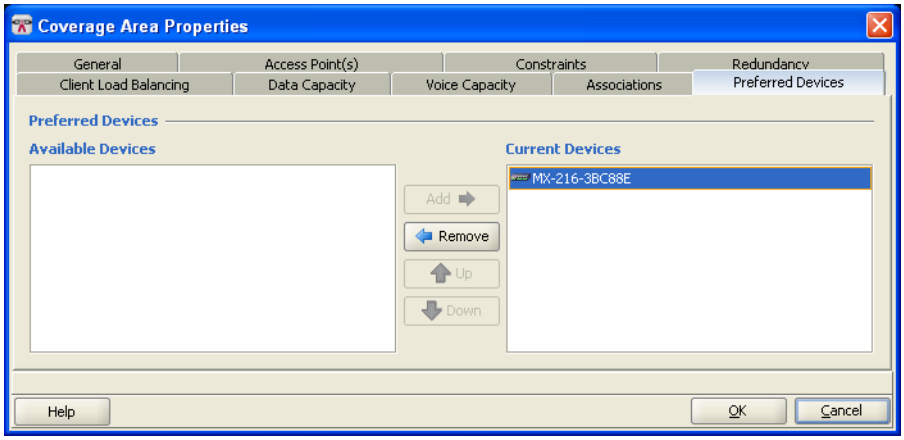
Preferred Devices Tab

The **Preferred Devices** tab has the following options:



1. In the **Available Devices** field, select an available MX, if one is configured, to use in the coverage area, then click **Add** to move the MX to the **Current Devices** field. This assumes that the network plan already has an MX defined. If you are planning a new installation, you do not need to specify an MX to use.
2. Click **OK** to save settings and close the dialog.

Computing and Placing APs

When you perform the **Compute and Place** procedure for one or more coverage areas, *RingMaster* automatically calculates the number of APs required and places them in appropriate locations on a floor. To do this, two calculations are performed in *RingMaster*. One is based on capacity (traffic engineering) and the other on pure RF coverage (at a given data rate). After calculations are made, the number of APs from capacity and from coverage are compared, and the larger count selected. If capacity wins, a grid pattern of APs is established. AP coverage positions are re-used, with excess APs remaining in their original grid position.

Using a “clean” RF model is imperative for best results. If you have many parallel RF obstacles that are close together, the placement algorithm tends to add more APs than are required. So, even with the automatic clean layout mechanism in *RingMaster*, complex drawings demand additional pruning and isolation of single RF obstacles objects to keep the RF obstacle count as low as possible. For more information about cleaning your floor plans, refer to **Cleaning Up a Drawing**.

When performing **Compute and Place** for a coverage area for the first time, the results do not account for existing APs. Manual overrides of the AP results are not taken into account if you perform Compute and Place again.

Determining Number and Placement of APs

1. Display a floor plan in the **Content** panel.
2. In the **Tasks** panel, click **RF Planning**.

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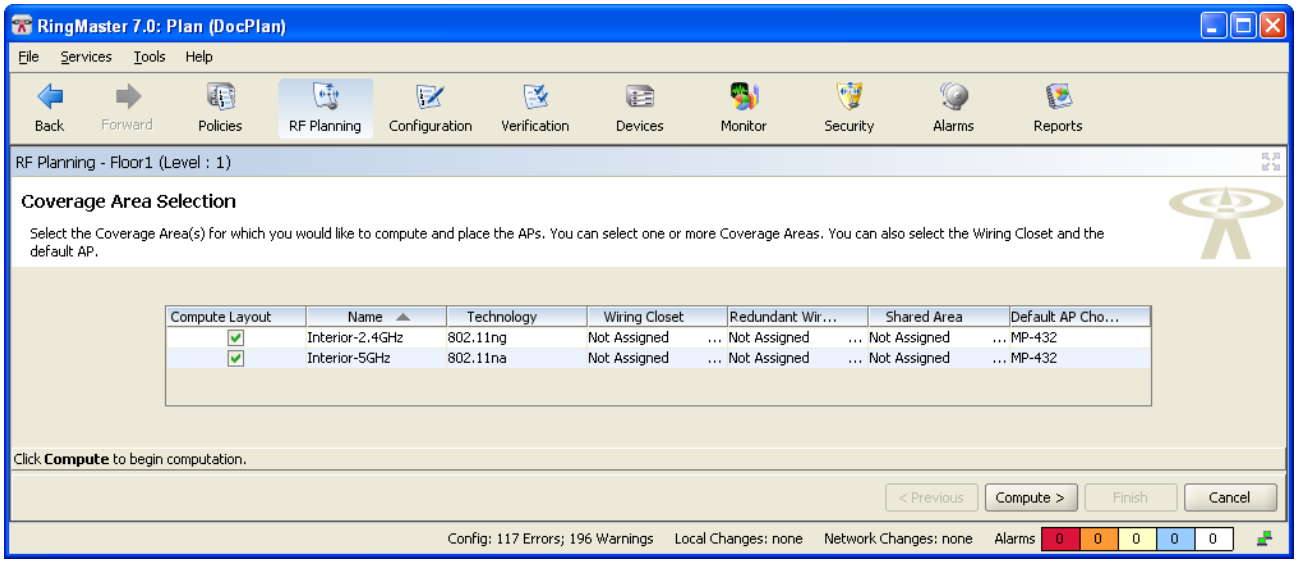
3. Under **RF Planning**, click **Compute and Place**. The **Compute and Place** window is displayed.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security Alarms Reports
RF Planning - Floor1 (Level : 1)
Coverage Area Selection
Select the Coverage Area(s) for which you would like to compute and place the APs. You can select one or more Coverage Areas. You can also select the Wiring Closet and the default AP.
Compute Layout
Name
Technology
Wiring Closet
Redundant Wir...
Shared Area
Default AP Cho...
Interior-2.4GHz 802.11ng Not Assigned Not Assigned Not Assigned MP-432
Interior-5GHz 802.11na Not Assigned Not Assigned Not Assigned MP-432
Click Compute to begin computation.
< Previous
Compute >
Finish
Cancel
Config: 117 Errors; 196 Warnings
Local Changes: none
Network Changes: none
Alarms 0 0 0 0 0

4. To remove a coverage area from AP placement/computation, clear the **Compute Layout** field.
5. To specify a primary wiring closet for a coverage area, click in the **Wiring Closet** column to display the wiring closet list and select a wiring closet.
6. Click **Compute**. The **Finalize AP Placement** window appears. Information is provided in the **Status** area about APs per coverage area and whether they were placed based on coverage or capacity. Review the number of AP access points required for each coverage area and the overriding criterion used (coverage or capacity).

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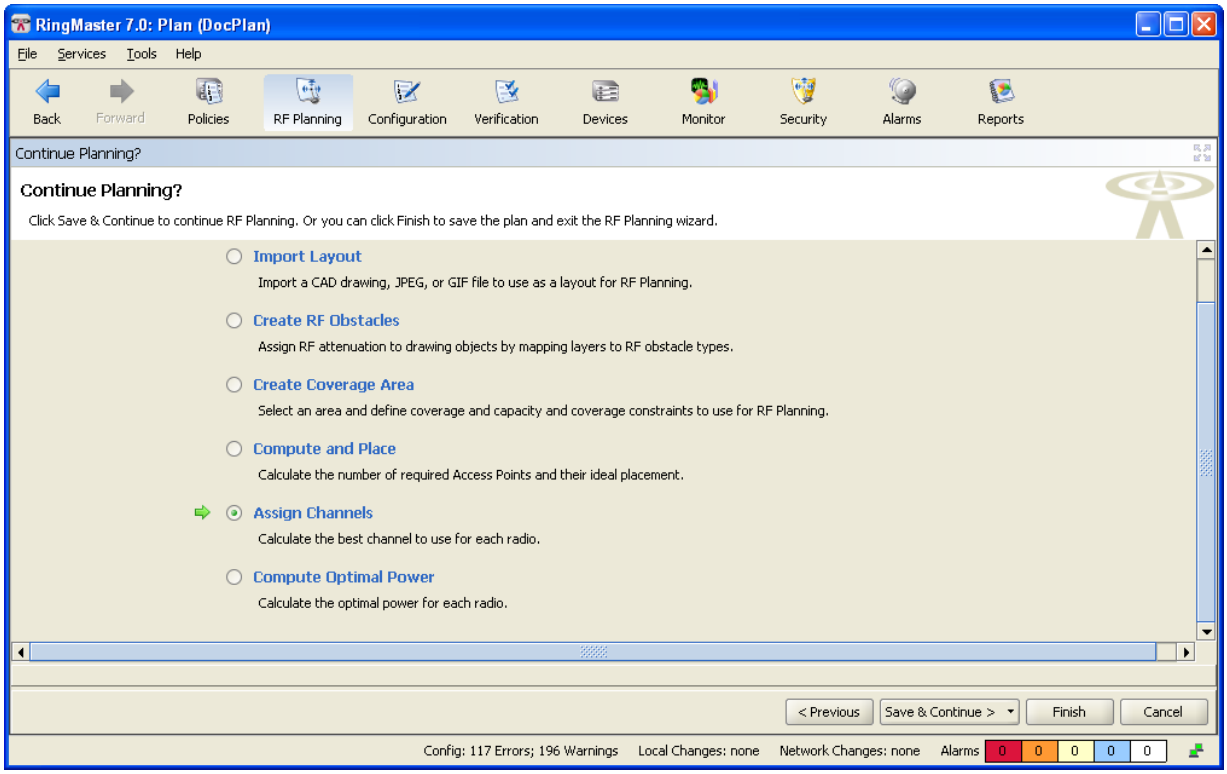
7. Click **Next** to apply changes. A **Continue Planning?** dialog is displayed with Assign Channels selected. Select **Save and Continue**.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security Alarms Reports
Continue Planning?
Continue Planning?
Click Save & Continue to continue RF Planning. Or you can click Finish to save the plan and exit the RF Planning wizard.
Import Layout
Import a CAD drawing, JPEG, or GIF file to use as a layout for RF Planning.
Create RF Obstacles
Assign RF attenuation to drawing objects by mapping layers to RF obstacle types.
Create Coverage Area
Select an area and define coverage and capacity and coverage constraints to use for RF Planning.
Compute and Place
Calculate the number of required Access Points and their ideal placement.
Assign Channels
Calculate the best channel to use for each radio.
Compute Optimal Power
Calculate the optimal power for each radio.
< Previous
Save & Continue >
Finish
Cancel
Config: 117 Errors; 196 Warnings
Local Changes: none
Network Changes: none
Alarms

Assigning Channels to APs

If you selected this option in the window shown above, you can assign channels to APs. Appropriate assignment of channels across the floor minimizes co-channel interference. The channel assignment algorithm assigns non-overlapping channels to neighboring APs from the selected channel set. Select the starting floor and the ending floor (in the downward direction) for multi-floor channel assignment. The algorithm takes predicted RSSI values between neighboring APs (including APs on different floors and 3rd party APs) and minimizes same-channel assignments between APs.

You can specify cross-floor attenuation and the 802.11 technology on which you want to perform the channel assignment. *RingMaster* uses predicted RSSI values for the imaginary “ray” that is drawn between two APs. Consequently, you might see unexpected results if the exact path between the APs has many obstacles, but the areas around that path are relatively open. You can make further manual adjustments, if necessary.

If you do not plan to use the RF Auto-Tuning feature to set channels on APs after deployment and installation, use the **Assign Channels to APs** option to assign channels to APs. Appropriate assignment of channels across a floor minimizes co-channel interference. The figure below shows

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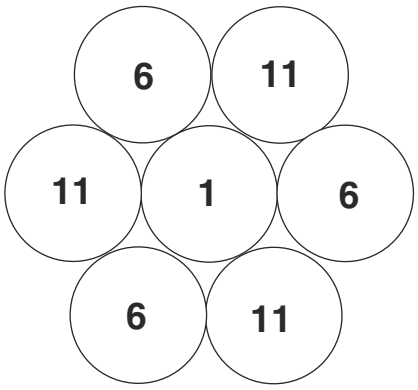
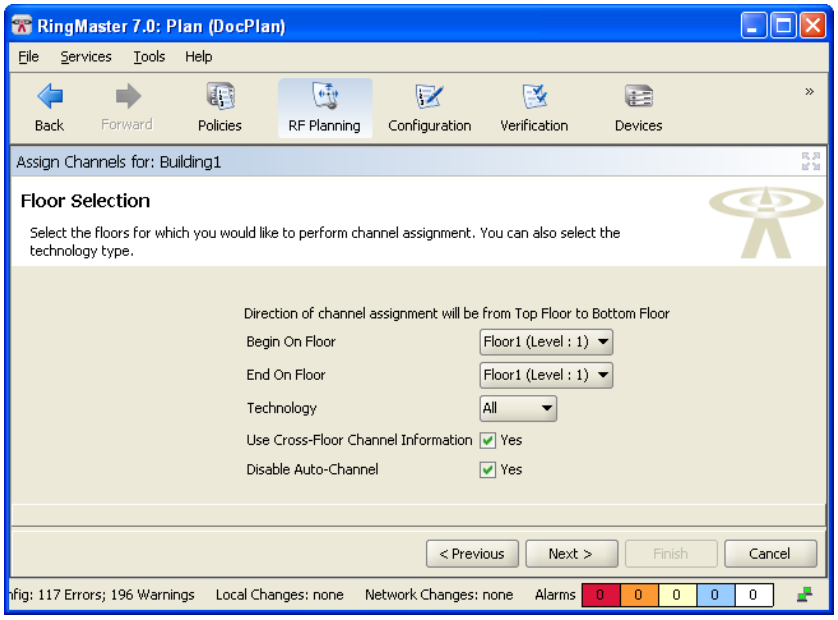
how to minimize co-channel interference for an 802.11b or 802.11g environment when using the nonoverlapping channels 1, 6, and 11.



To assign channels:

1. Display the floor plan in the **Content** panel.
2. In the **Tasks** panel, click **RF Planning**.
3. Under **RF Planning**, click **Assign Channels**. The **Floor Selection** dialog appears, showing the current channel assignment constraints.



4. To change the starting floor for channel assignment, select the floor from the **Begin On Floor** list. By default, *RingMaster* starts at the top floor and works down.
5. To change the ending floor for channel assignment, select a floor from the **End On Floor** list. The ending floor number must be lower than or equal to the starting floor number.
6. To change the radio type assigned to channels, select a radio type from the **Technology** list. By default, *RingMaster* assigns channels for all radio types on the AP access points placed in the building.
7. To prevent *RingMaster* from using channel assignments for the floor above when calculating channel assignments for a floor, clear **Use Cross-Floor Channel Information**.
8. Click **Next**. The **Channel Assignment Progress** window appears.

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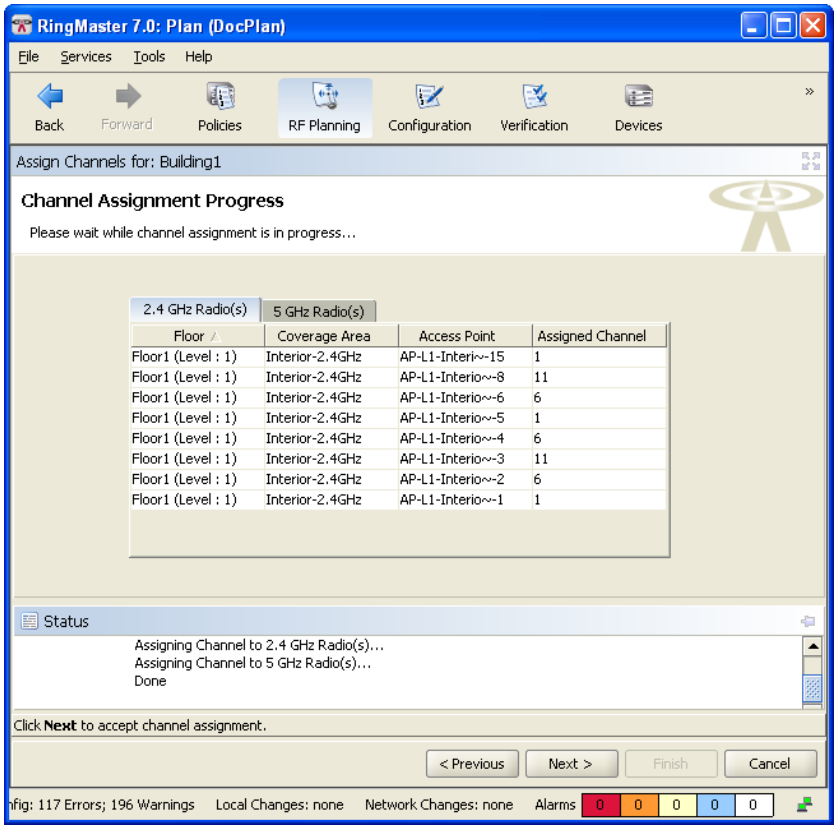
9. Review results. 802.11a channel assignments are listed under the **2.4 GHz Radio(s)** tab. 802.11b/g channel assignments are listed under the **5 GHz Radio(s)** tab.


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices
Assign Channels for: Building1
Channel Assignment Progress
Please wait while channel assignment is in progress...
2.4 GHz Radio(s)
5 GHz Radio(s)
Floor
Coverage Area
Access Point
Assigned Channel
Floor1 (Level : 1) Interior-2.4GHz AP-L1-Interi~-15 1
Floor1 (Level : 1) Interior-2.4GHz AP-L1-Interio~-8 11
Floor1 (Level : 1) Interior-2.4GHz AP-L1-Interio~-6 6
Floor1 (Level : 1) Interior-2.4GHz AP-L1-Interio~-5 1
Floor1 (Level : 1) Interior-2.4GHz AP-L1-Interio~-4 6
Floor1 (Level : 1) Interior-2.4GHz AP-L1-Interio~-3 11
Floor1 (Level : 1) Interior-2.4GHz AP-L1-Interio~-2 6
Floor1 (Level : 1) Interior-2.4GHz AP-L1-Interio~-1 1
Status
Assigning Channel to 2.4 GHz Radio(s)...
Assigning Channel to 5 GHz Radio(s)...
Done
Click Next to accept channel assignment.
< Previous
Next >
Finish
Cancel
fig: 117 Errors; 196 Warnings
Local Changes: none
Network Changes: none
Alarms

10. Click **Next** to accept channel assignments. New channel assignments are reflected in the **Coverage Areas** panel.

Computing Optimal Power

The **Compute and Place** procedure is performed using maximum allowed power for a selected channel in the defined regulatory domain. Optimal power can be computed for each AP, where transmit power is adjusted (up or down) to provide adequate coverage with minimum RF interference. When calculating optimal power, you can manually change positions and counts of APs (add or remove APs) until final power optimization is performed. Changing AP quantities and positions is quite typical, given that an operator can interpret the floor plan and understand any cabling constraints to avoid any positioning problems.

Transmit power levels must be high enough to adequately cover an area, but low enough to minimize co-channel interference. *RingMaster* factors in these considerations when calculating optimal power.

If you do not plan to use the RF Auto-Tuning feature to automatically set power levels on APs after deployment and installation, use the **Compute Optimal Power** option to calculate power settings for APs. Transmit power levels must be high enough to adequately cover an area, but low enough to minimize co-channel interference. *RingMaster* factors in these considerations when calculating optimal power.

Trapeze Networks recommends that you assign channels before you compute optimal power, to ensure successful power computation.

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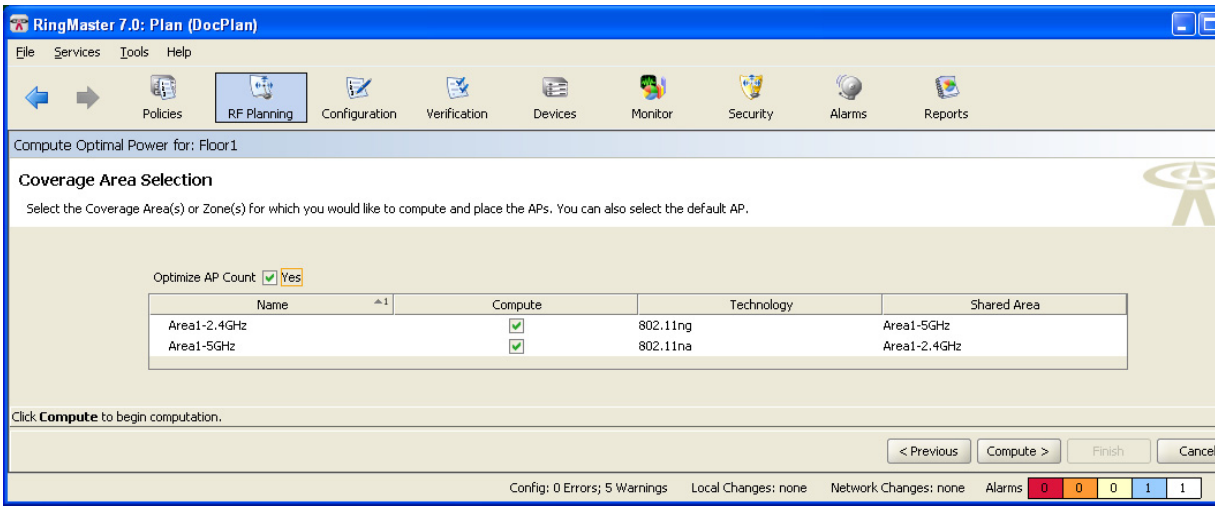
If the AP is using an external antenna, specify the antenna model and the coverage direction of the antenna before computing power.

To compute optimal power:

1. In the **Tasks** panel, click **RF Planning**.
2. Under **RF Planning**, click **Compute Optimal Power**. The **Coverage Area Selection** window appears, displaying a list of areas you defined and corresponding technology.



3. Make selections, then click **Compute**.

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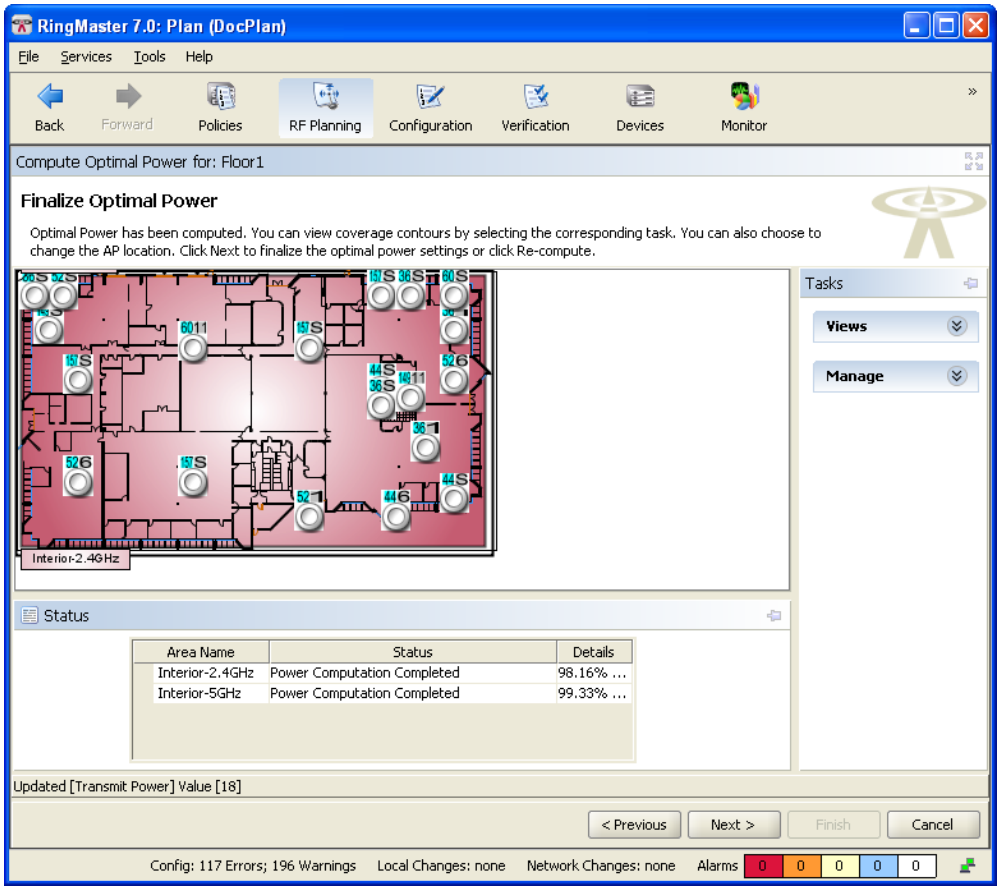
4. The **Finalize Optimal Power** window opens. In the **Status** area are coverage and data rate numbers determined by the **Compute** process.



Click **Next**.

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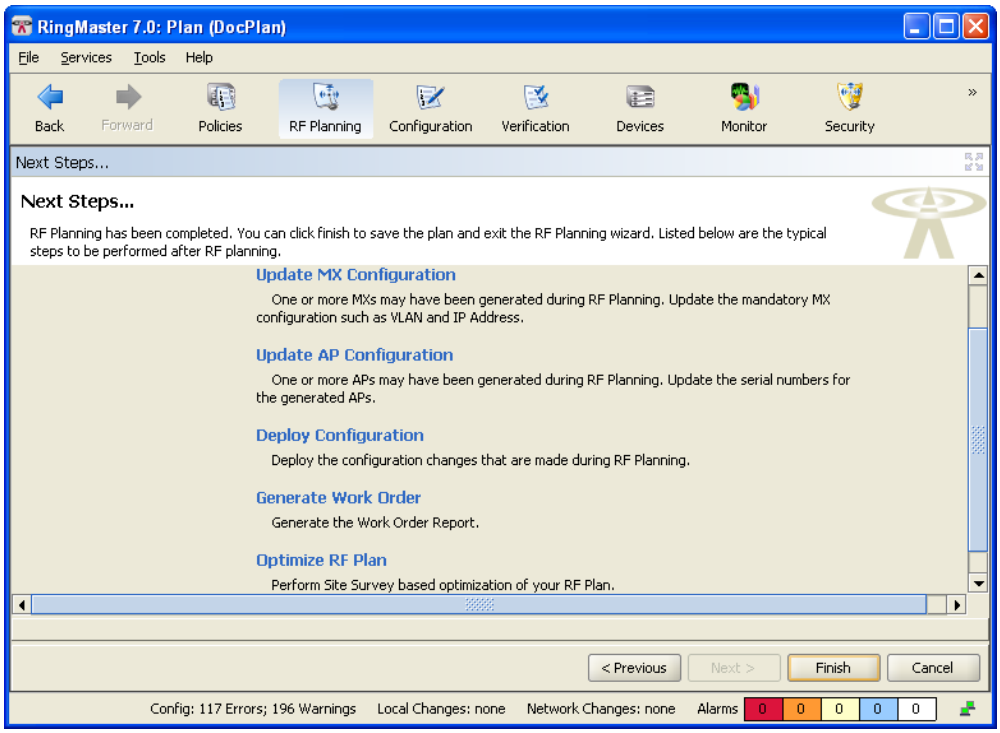
5. A **Next Steps** dialog is displayed. Click **Finish.**


RingMaster 7.0: Plan (DocPlan)
File Services Tools Help
Back Forward Policies RF Planning Configuration Verification Devices Monitor Security
Next Steps...
Next Steps...
RF Planning has been completed. You can click finish to save the plan and exit the RF Planning wizard. Listed below are the typical steps to be performed after RF planning.
Update MX Configuration
One or more MXs may have been generated during RF Planning. Update the mandatory MX configuration such as VLAN and IP Address.
Update AP Configuration
One or more APs may have been generated during RF Planning. Update the serial numbers for the generated APs.
Deploy Configuration
Deploy the configuration changes that are made during RF Planning.
Generate Work Order
Generate the Work Order Report.
Optimize RF Plan
Perform Site Survey based optimization of your RF Plan.
< Previous
Next >
Finish
Cancel
Config: 117 Errors; 196 Warnings
Local Changes: none
Network Changes: none
Alarms 0 0 0 0 0

AP Placement Details

After providing information about floor plans, RF obstacles, and wireless coverage requirements, *RingMaster* can design the wireless network for a floor using the following process:

- Compute and place AP access points (See **Computing and Placing AP Access Points for a Coverage Area**.)
- Assign channels to AP access points
- Compute optimal power (See **Computing Optimal Power**.)

RingMaster determines the number of AP access points to be installed in an area and the number of MXs needed in a wiring closet (if the floor has them), then places them on the floor plan. You can move AP access points on a floor plan to more convenient locations to simplify installation. *RingMaster* also determines the MX to connect to an AP.

RingMaster assigns transmit power levels and channels for each AP. Power levels and association rates are set to optimize cell sizes for a coverage area. *RingMaster* shows expected (simulated) coverage of a completed design, allowing you to see how coverage changes when you make adjustments to AP location or power levels.

Computing and Placing AP Access Points for a Coverage Area

When you perform **Compute and Place** for one or more coverage areas, *RingMaster* calculates the number of access points required based on area information and places them in appropriate locations on a floor. *RingMaster* assumes APs are mounted on the ceiling and considers ceiling height when placing APs. *RingMaster* assumes coverage down to 3 feet above the floor (a user's desk). By default, *RingMaster* assumes you want to directly connect AP access points to MXs without redundant AP connections for backup. You can change these design constraints.

By default, when you are performing **Compute and Place** for a coverage area for the first time, results do not account for existing AP access points. Manual overrides of AP results are not taken into account if you perform **Compute and Place** again. If you are modifying an existing coverage area with deployed AP access points, or if you need to preserve manual changes made to the current configuration, you can lock APs. Locked APs cannot be moved or deleted during a **Compute and Place** process.

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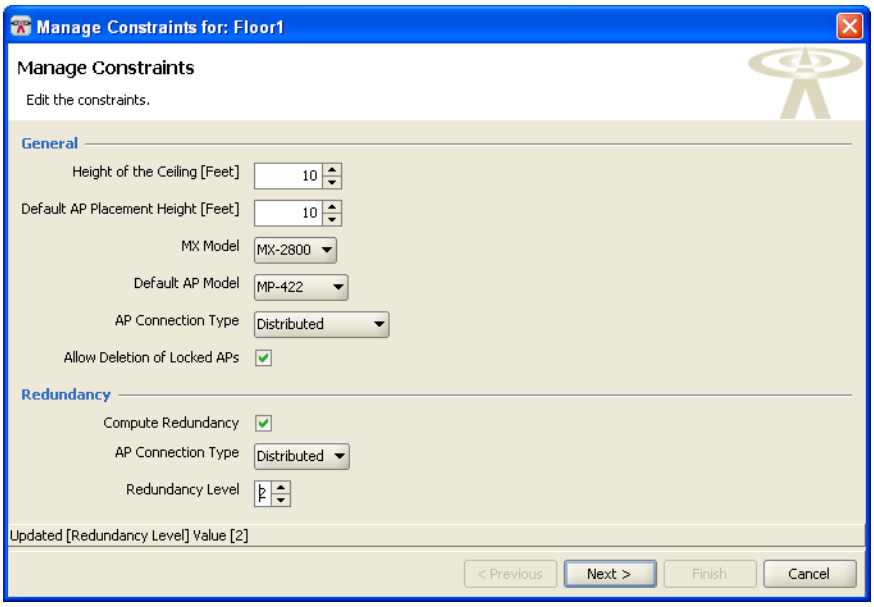
Placing AP Access Points

1. Display a floor plan in the **Content** panel.
2. In the **Tasks** panel, click **Floor**.
3. **Under Edit Floor,** click **Constraints.** The **Manage Constraints** dialog is displayed.



4. To change ceiling height, specify a new height in the **Height of the Ceiling** field.
5. To change the height where APs are mounted, specify a new mounting height in the **AP Placement Height** field.
6. To change MX model, select a model from the **MX Model** list.
7. To change AP connection type, select a type from the **AP Connection Type** list:
   - **Distributed** — APs can be indirectly attached through intermediate Layer 2 or Layer 3 devices.
   - **Distributed (Auto)** — APs can be indirectly attached through intermediate Layer 2 or Layer 3 devices. They receive their configuration automatically using a profile that assigns a Distributed AP number and name to the AP from among the unused valid AP numbers available on the switch.
8. To allow locked AP access points to be deleted when **Compute and Place** determines they are no longer required, select **Allow Deletion of Locked APs**. A locked AP is an AP that is already associated with a coverage area. For example, if you computed and placed APs in an coverage area on a previous occasion and you are now optimizing the plan, APs are still associated with the coverage area. (See **Locking and Unlocking AP Access Points**.)
9. To plan for redundant AP connections to MXs, select **Compute Redundancy**.

Only AP models with two Ethernet ports can support redundant direct connections. However, models with one Ethernet port can support redundant distributed connections.

10. AP connection type for a redundant connection allows only selection of **Distributed** from the **AP Connection Type** list.
11. To change the number of redundant connections for a distributed connection type, type the number in the **Redundant Level** field. For direct connections, redundancy level is always 1.

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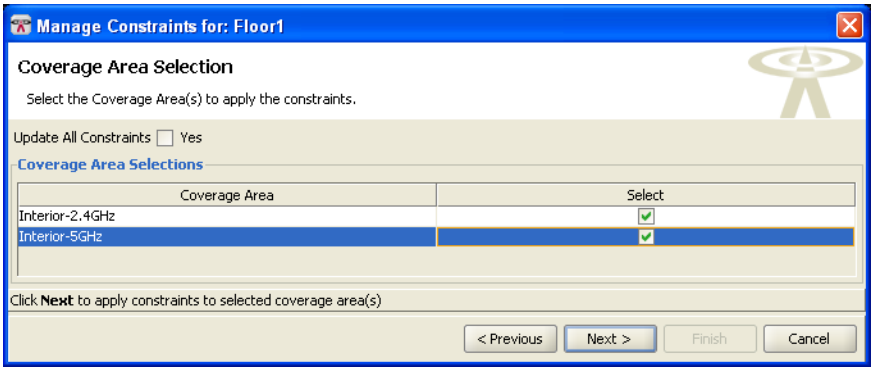
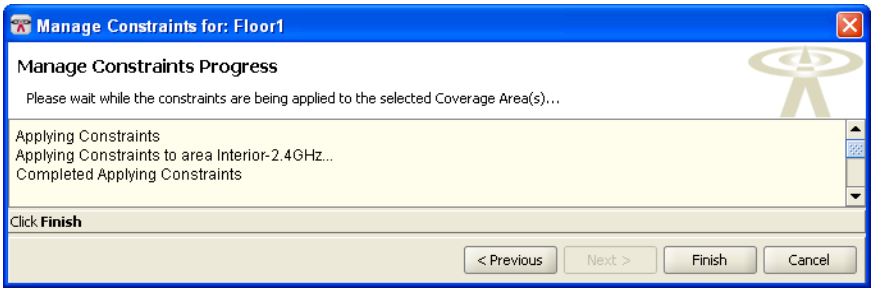
12. Click **Next**. The **Coverage Area Selection** dialog is displayed.



13. To update the constraints for selected coverage areas, select **Update All Constraints**. By default, *RingMaster* applies only changed constraint values to the selected areas. This default behavior preserves any constraint changes to individual areas when you configure them.
14. Select coverage areas for which you want to apply constraints. To select a coverage area, click its icon in the select column or click on the **Select** box.

    Click **Next**.
15. When the **Manage Constraints Progress** displays the “Completed Applying Constraints”, click **Finish** to save changes.



Compute and Place AP Access Points

To compute and place AP access points:

1. Display a floor plan in the **Content** panel.
2. In the **Tasks** panel, click **RF Planning**.

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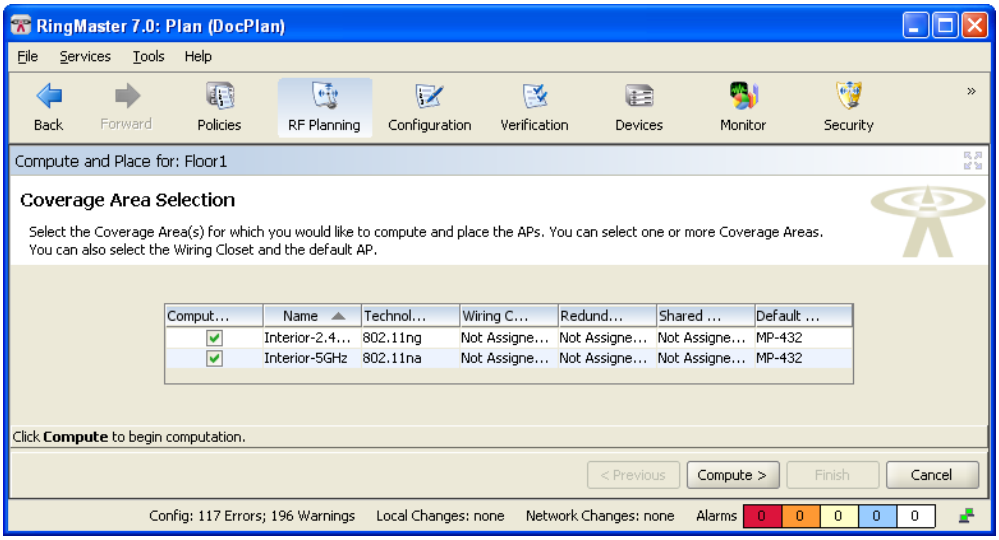
3. Under **RF Planning**, click **Compute and Place**. The **Compute and Place** wizard appears.



4. To remove a coverage area from AP placement and computation, clear the **Compute Layout** checkbox for the area.
5. To specify a primary wiring closet for a coverage area, click on the **Wiring Closet** column to display the wiring closet list and select a wiring closet from the list. You must specify a primary wiring closet for directly attached AP access points. Specifying a primary wiring closet for distributed APs is optional.
6. To specify a redundant wiring closet for a coverage area, click in the **Redundant Wiring Closet** column and select a wiring closet from the list. This step is optional.
7. To specify a shared area for a coverage area, click in the **Shared Area** column to display a shared area list and select a coverage area from the list. This step is optional.
8. To specify the default AP to be used in a coverage area, click in the **Default AP Choice** column to display a list of APs and select an AP from the list. This step is optional.

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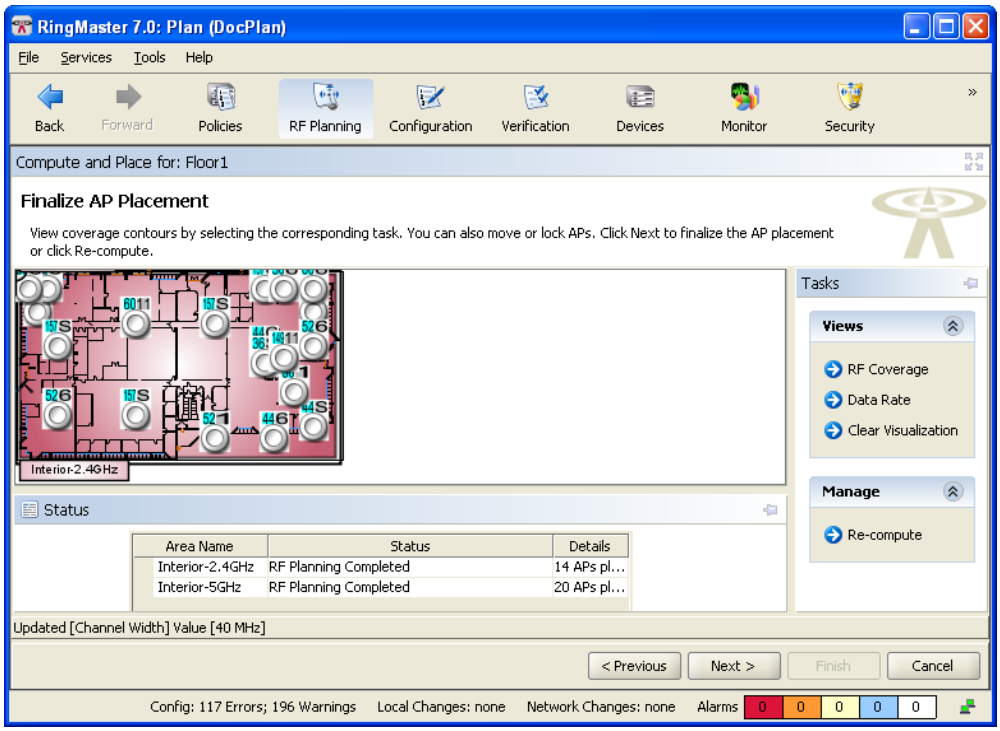
9. Click **Compute**. The **Finalize AP Placement** dialog is displayed.



You can move APs to solve coverage problems, etc. and then click **Re-compute** to see revised visualization results.

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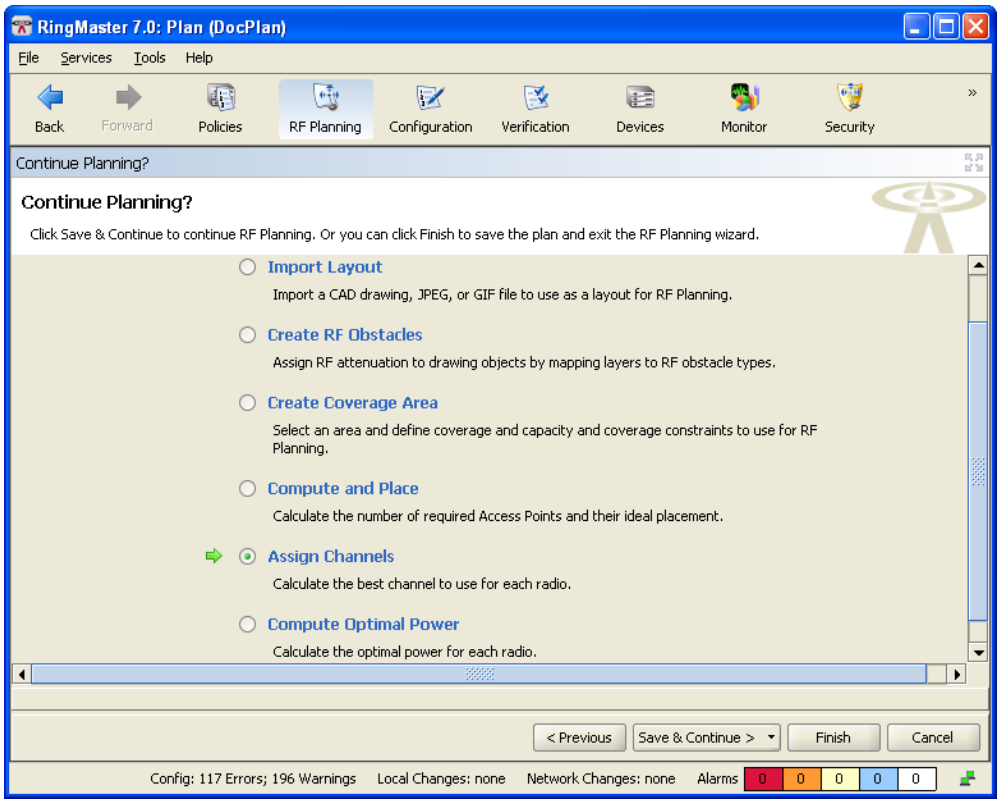
10. Click **Next**. The **Continue Planning?** window is displayed that allows you to select another planning function or click **Finish**.



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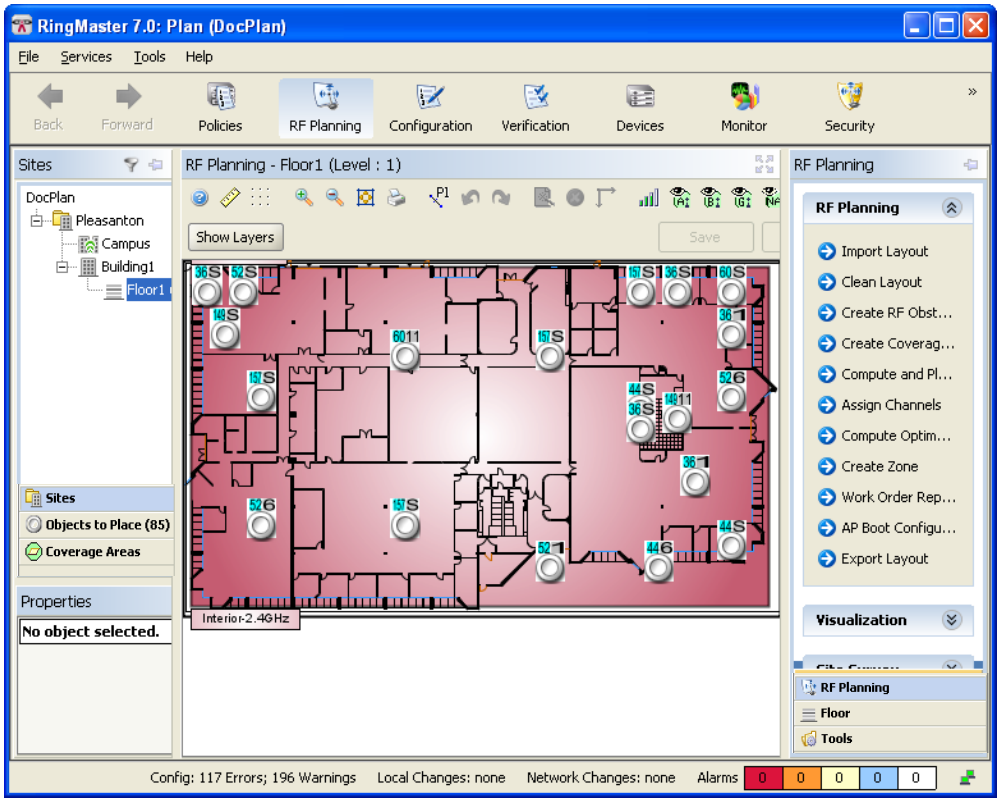
- If you click **Finish** to apply changes, icons for suggested AP access point locations appear on the floor plan.



To see the RF coverage for an area, right-click (Macintosh: Control+click) on the area (either in the organizer panel or on the floor) and select **Show RF Coverage**. If the area supports more than one radio technology, you also need to select the technologies. Available choices depend on the wireless technology you chose for the coverage area.

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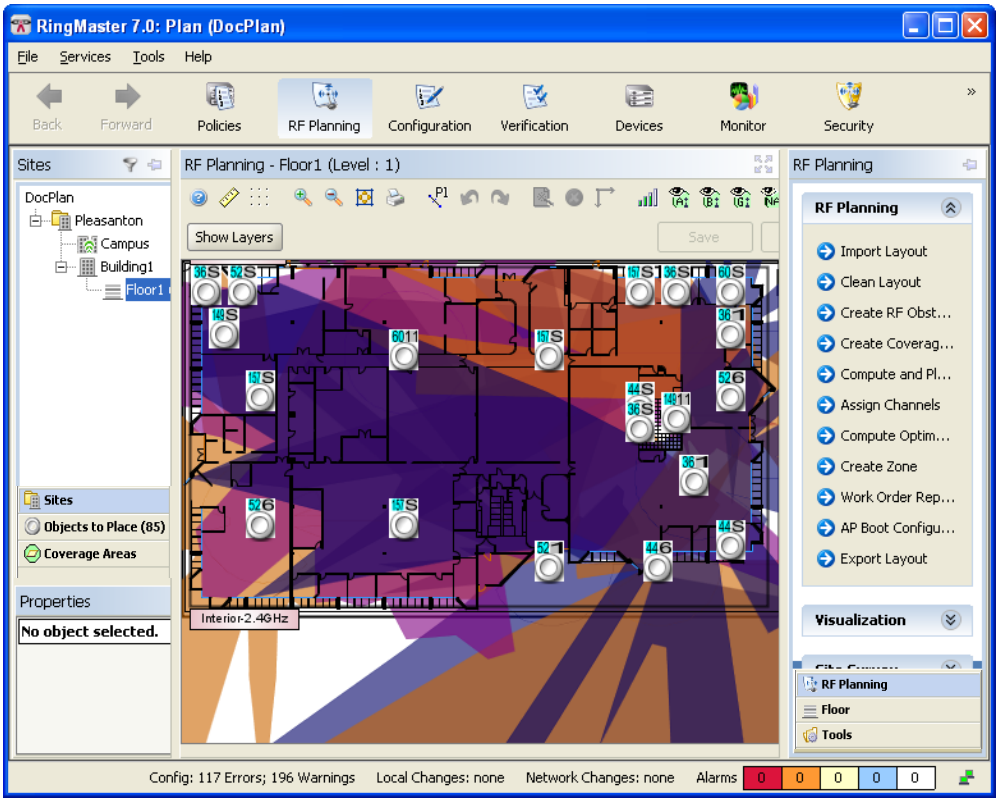
The following graphic shows an example of multiple technology coverage for an area.



11. To see the RF coverage area for a specific AP or radio, right-click (Macintosh: Control+click) the AP or radio, and select one of the following:
    - **Show RF Coverage > 802.11a**
    - **Show RF Coverage > 802.11b**
    - **Show RF Coverage > 802.11g**
    - **Show RF Coverage > 802.11na**
    - **Show RF Coverage > 802.11ng**

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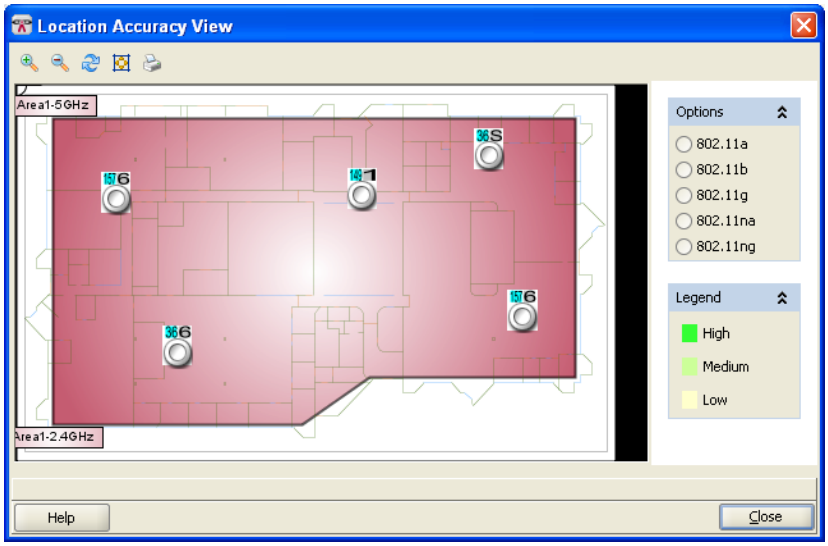
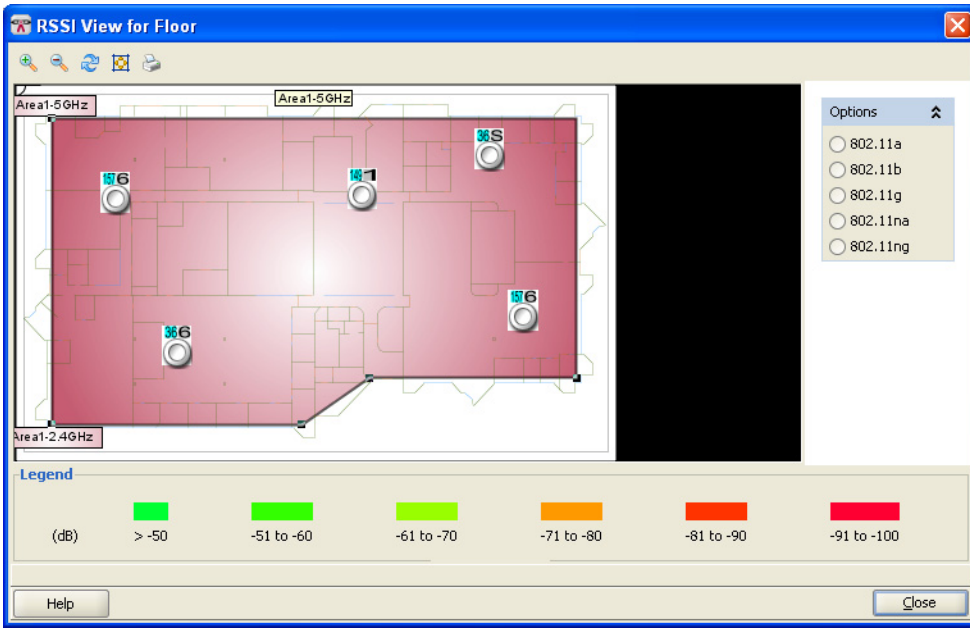
12. You can view **Location Accuracy** and access an **RSSI Visualization** for an area.





Locking and Unlocking Coverage Areas

After creating a coverage area, *RingMaster* automatically locks the area. Unlock the coverage area if you need to move or resize it.

To unlock a coverage area:

1. Select the coverage area on the floor or from the **Coverage Areas** list in the **Organizer** panel.

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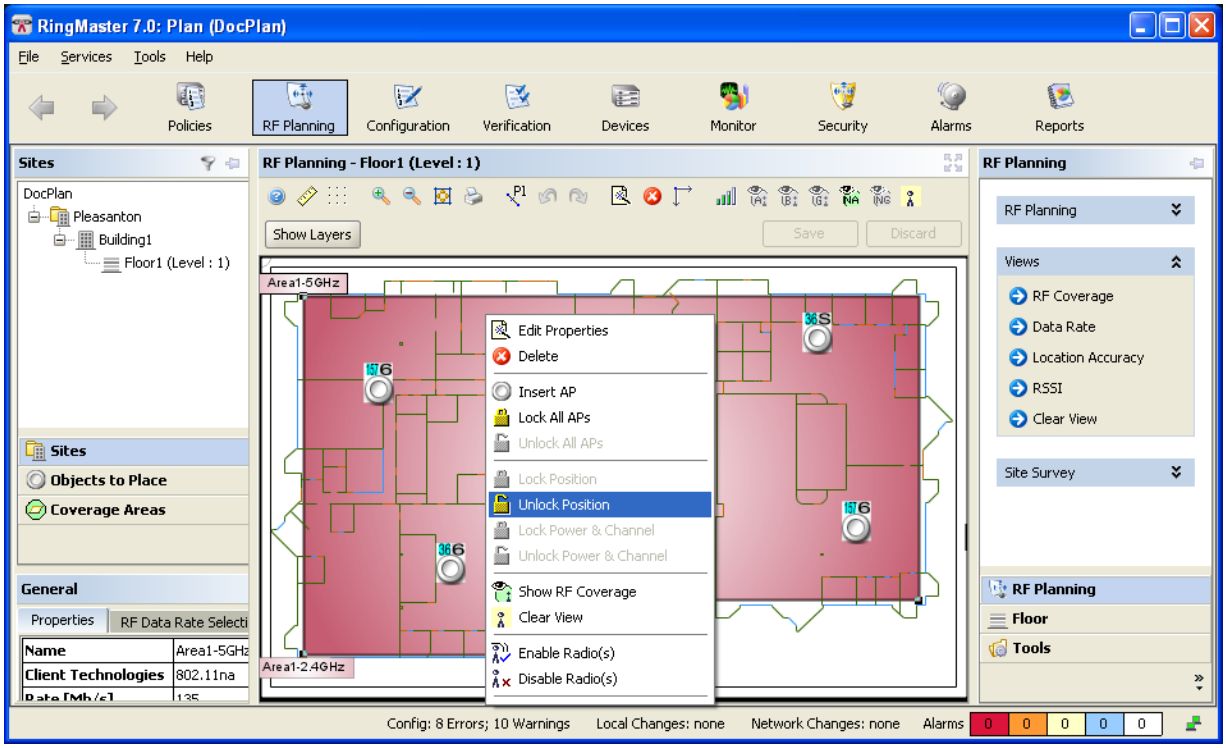
2. Right-click (Macintosh: Control+click), and select **Unlock Position**. You can now move or resize the coverage area.



3. To relock the coverage area:
   a. Select a coverage area.
   b. Right-click (Macintosh: Control+click), and select Lock.

Locking and Unlocking AP Access Points

After computing and placing the necessary AP access points for a coverage area, you can move them to fine-tune the wireless coverage. If you need to fix an AP to a location on the floor, lock the current location when you recompute the necessary coverage. A dual-radio AP model that is part of two coverage areas and is not locked can be placed in the shared coverage area.

To lock an AP:

1. Select the AP.

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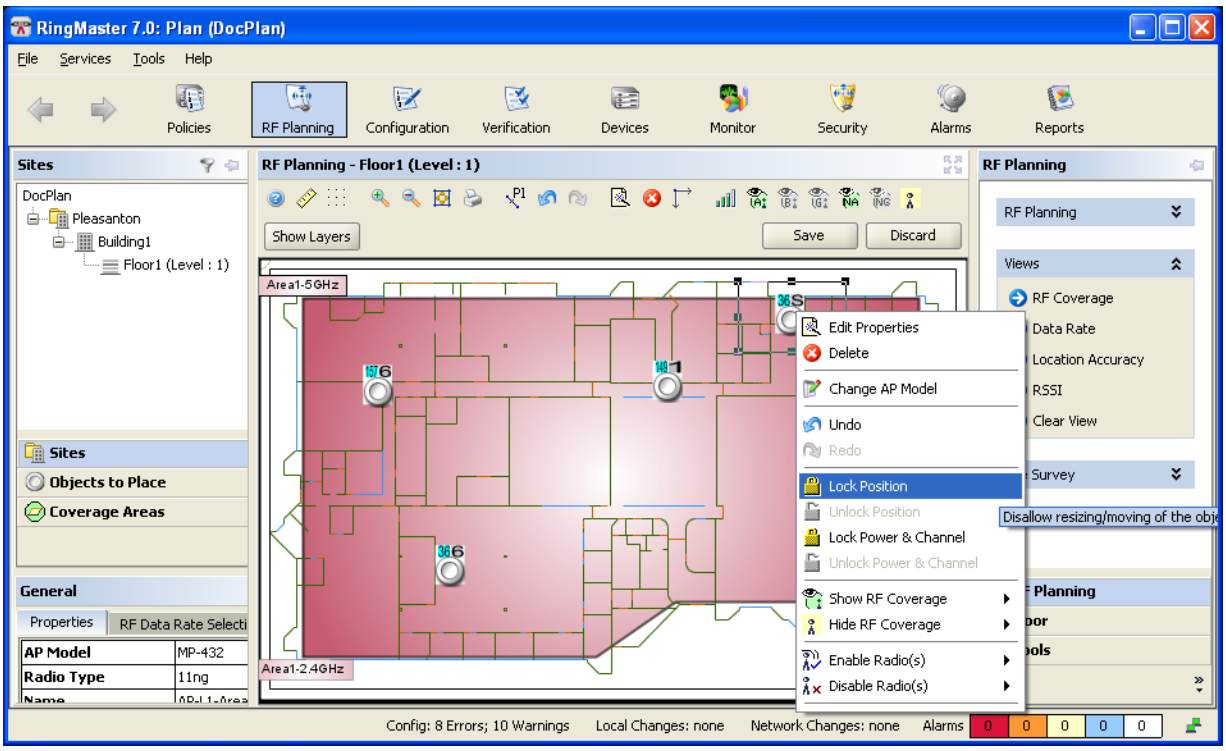
2. Right-click (Macintosh: Control+click), and select **Lock**. You can no longer move the AP.



Coverage Areas That Could Not Be Optimized

If power levels for one or more coverage areas could not be optimized, show the RF coverage at baseline association and minimum transmit rates for coverage areas by doing the following:

1. From the **Visualization** area in the **Tasks** panel, there are several tools:
   - **RF Coverage** — Coverage is shown in colored bands representing coverage by technology.
   - **Data Rate** — Coverage is shown in colored bands representing data transmission rates supported by a radio. These rates are standard for each radio type.
   - **Location Accuracy** — Coverage is shown based on location accuracy of radios.
   - **RSSI** — Coverage is shown based on Received Signal Strength Indication (RSSI) at other radios.
   - **Clear Visualization** — Clears visualization displays.
2. In the **Coverage Areas** section of the **Organizer** panel, select a scope for display coverage. You can display coverage for an individual radio, a specific coverage area, or all coverage areas on a floor.
   - To select multiple contiguous objects, click **Shift** while selecting.
   - To select multiple non-contiguous objects, click **Ctrl** (Macintosh: Command) while selecting.

To make adjustments, do the following:

1. Manually move AP access points, or increase transmit power levels.
2. Manually create more AP access points, and place them on a floor.

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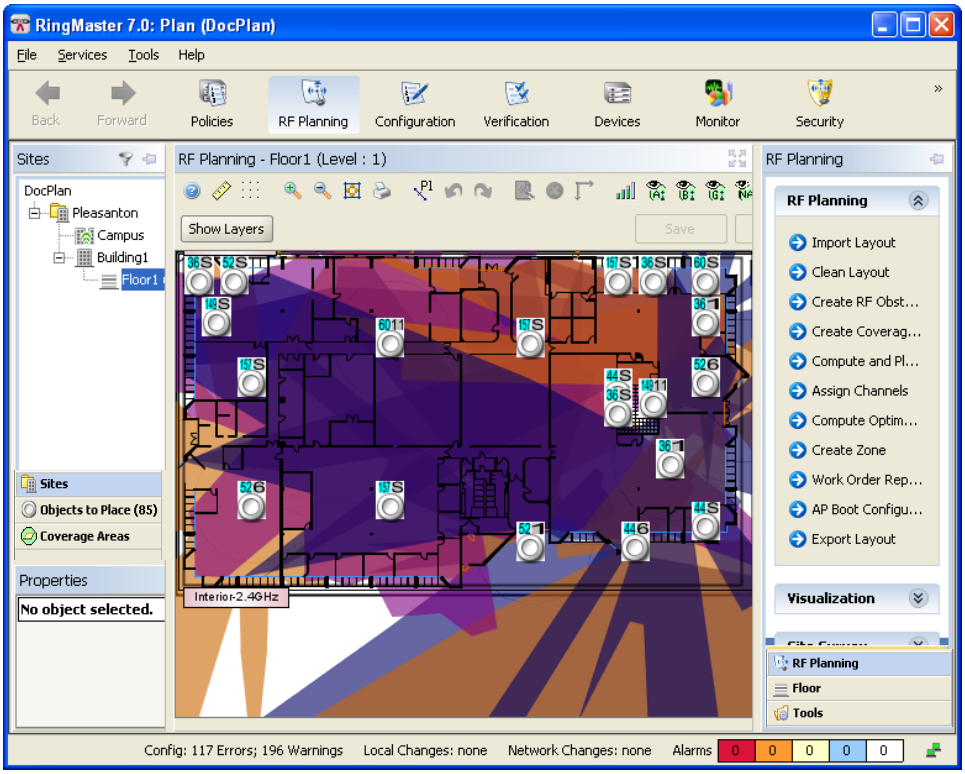
3. Modify a coverage areas so capacity capabilities are higher.

If you manually add AP access points to a coverage area, they might be moved or removed the next time you perform **Compute and Place**.

Displaying Coverage

Looking at RF coverage allows you to see if an area is adequately covered by APs. You can move APs to see how coverage changes.

1. From the **Visualization** area in the **Tasks** panel, there are several tools:
   - **RF Coverage** — Coverage is shown in colored bands representing coverage by technology.
   - **Data Rate** — Coverage is shown in colored bands representing data transmission rates supported by a radio. These rates are standard for each radio type.
   - **Location Accuracy** — Coverage is shown based on location accuracy of radios.
   - **RSSI** — Coverage shown uses Received Signal Strength Indication (RSSI) at other radios.
   - **Clear Visualization** — Clears visualization displays.
2. Right-click (Macintosh: Control+click) on a coverage area and select **Show RF Coverage**.
3. **Select the A, B, or G icon from the toolbar** to view the coverage area for that technology. The coverage area is displayed, color-coded by channel.



If a coverage area provided by an AP on the floor above or below is one meter or less, *RingMaster* displays a message. This coverage area is not displayed on the floor plan.

Creating Additional Wiring Closets

To create a new wiring closet on a floor:

1. Display the floor plan in the **Content** panel.

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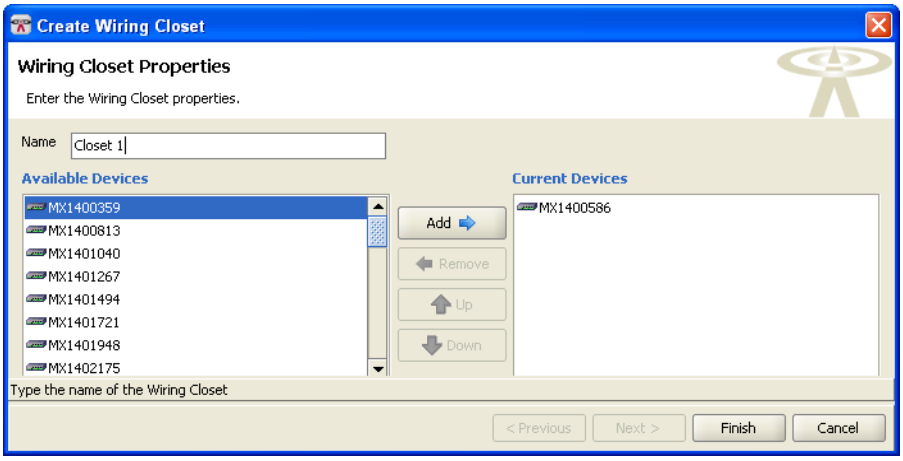
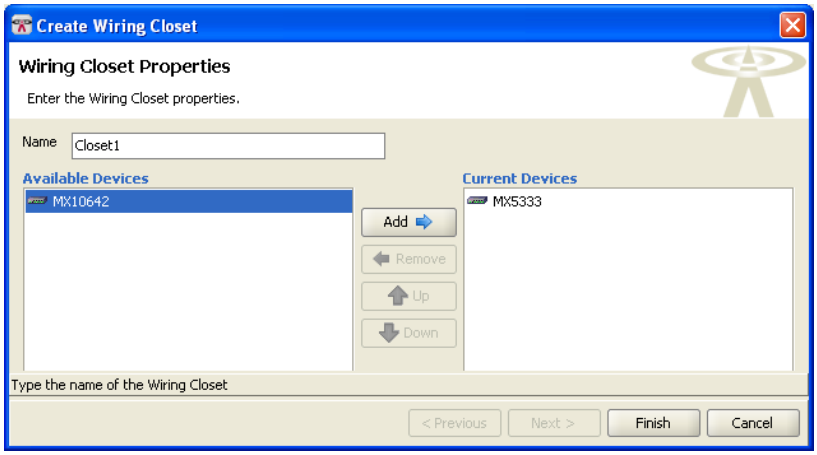
2. In the **Tasks** panel, click **Tools**.
3. In the **Wiring Closet/Misc** area under **Coverage Area**, click the (Insert Wiring Closet) icon.
4. Click in the floor display where you want to place the wiring closet. The **Wiring Closet Properties** dialog appears.



5. In the **Name** field, type the name of the wiring closet (1 to 60 characters, with no tabs).
6. If you have not defined an MX in *RingMaster*, click **Finish** to save changes. Otherwise, go to **Step 7**. *RingMaster* determines how many MXs are needed when computing the number of AP access points required and automatically creates them.
7. To add a previously created MX to a wiring closet, select the MX in the **Available Devices** list, then click **Add** to move it to the **Current Devices** field.



To remove an MX from a wiring closet, select the MX in the **Current Devices** list, then click **Remove** to move it to the **Available** Devices field. If there are two or more MXs in a wiring closet, you can change the order *RingMaster* uses to check switches for free ports. If there are no free ports on listed switches, *RingMaster* creates and inserts a new MX in the wiring closet. Select an MX and click **Up** or **Down** to change the order of the MXs.

8. Click **Finish** to save changes.

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Placing Third-Party Access Points

If you have third-party access points in your network, you can place icons for them on your floor layout and configure their radio attributes using *RingMaster*. The radio attributes are taken into consideration when *RingMaster* assigns channels to APs.

- If you add third-party access points while using the **Configuration** Navigation Bar button, the access points are listed in **RF Planning** on the **Objects to Place** tab, and you can move them to their locations on the floor plans. (See **Moving a Third-Party AP Icon to its Floor Location**.)
- You also can add third-party access points in **RF Planning**. (See **Creating and Placing an Icon for a Third-Party Access Point**.)

Moving a Third-Party AP Icon to its Floor Location

If you added a third-party access point while using the **Configuration** Navigation Bar button, the access point is on the **Objects to Place** tab.

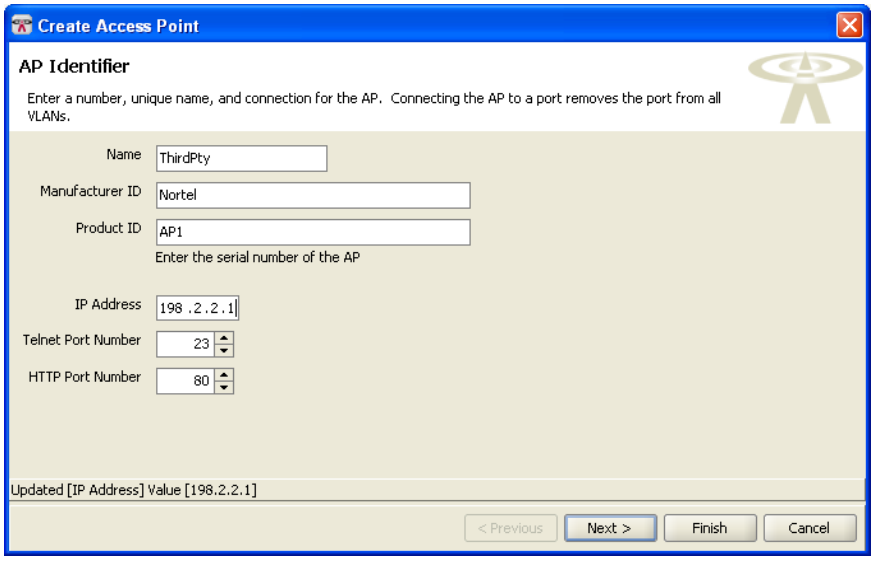
1. In **RF Planning**, navigate to the floor plan.
2. In the **Organizer** panel, click **Objects to Place**.
3. Select the icon or description of the AP.
4. On the floor plan, click on a location where you want to place the AP.

You must click in a coverage area.

RingMaster removes AN AP from **Objects to Place** and places an icon on the floor plan.

Creating and Placing an Icon for a Third-Party Access Point

1. In **RF Planning**, navigate to a floor plan.
2. In the **Tasks** panel, click **Tools**.
3. In the **Coverage Area** task group, under **`Wiring Closet/Misc`**, click the (Insert Third-Party AP) icon
4. On the floor plan, click where you want the third-party access point to be placed. The **Create Third-Party AP** wizard appears.



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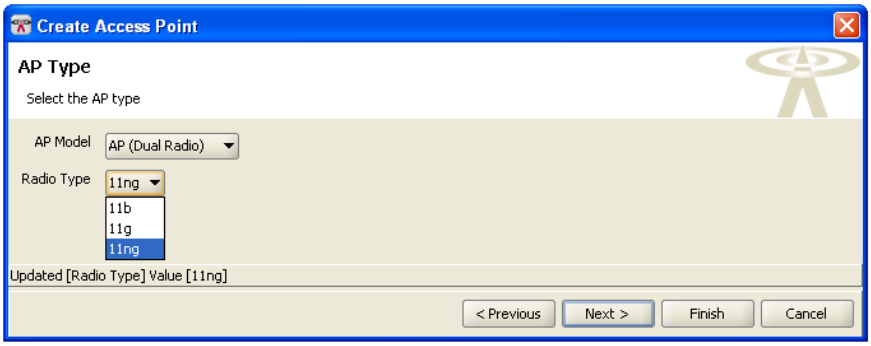
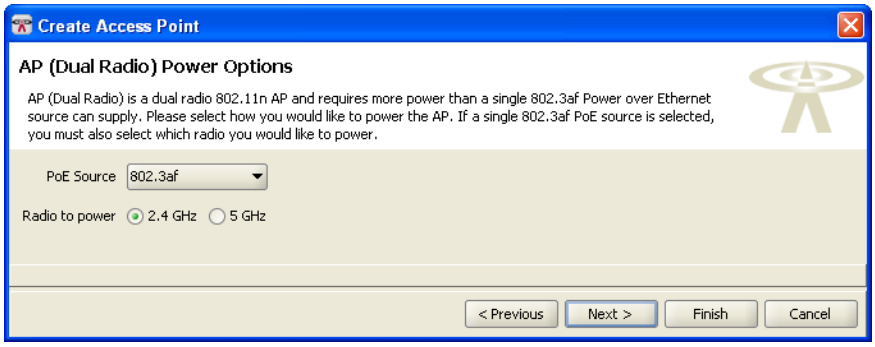
5. In the **Name** field, type a name for the access point. You can use 1 to 32 characters, with no punctuation except the following: period (.), hyphen (-), or underscore (_).
6. Optionally, in the **Manufacturer ID** field, type the manufacturer identification for the access point (1 to 30 characters, with no spaces).
7. In the **Product ID** field, type the product identification for the access point (1 to 30 characters, with no spaces).
8. In the **IP Address** field, type the IP address for the access point. If you specify an IP address, you can use Telnet and a Web browser with this access point.
9. From the **Telnet Port Number** list, specify the port number for Telnet service.
10. From the **HTTP Port Number** list, specify the port number for HTTP service.
11. Click **Next**. The following dialog appears:



12. From the **AP Model** and Radio Type pull-down lists, select from the following:
    - AP (Single Radio) — 802.11a, 802.11b, 802.11g, 802.11na, 802.11ng
    - AP (Dual Radio) — 802.11b, 802.11g, or 802.11ng
13. Click **Next**. The following dialog appears:


Create Access Point
AP (Dual Radio) Power Options
AP (Dual Radio) is a dual radio 802.11n AP and requires more power than a single 802.3af Power over Ethernet source can supply. Please select how you would like to power the AP. If a single 802.3af PoE source is selected, you must also select which radio you would like to power.
PoE Source
802.3af
Radio to power
2.4 GHz
5 GHz
< Previous
Next >
Finish
Cancel

14. Select a **PoE Source** from the list as follows:
    - High Power
    - 802.3af
    - Dual 802.3af

    If you select 802.3af, select the radio to power using either the 2.4 GHz or 5 GHz check box.

    Click **Finish** to save changes.

Placing Installed and Auto-Configured APs

You can place APs already installed on a floor into the network plan. To do this, upload the MX configuration into *RingMaster*, associate AP(s) with a coverage area, then place them on the floor plan. In addition, APs that receive their configuration using a profile are automatically added to the

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network plan. They appear under **Objects to Place** in the **Organizer** panel. From the **Objects to Place** panel, you can place these APs onto the floor plan.

To place installed APs on the floor plan:

1. Select the **Devices** button on the main *RingMaster* Navigation Bar, click **Upload MX**, and upload an MX configuration into *RingMaster*.
2. Select the **RF Planning** button on the main **RingMaster** Navigation Bar and display a floor plan in the **Content** panel.
3. In the **Coverage Areas** section, right-click (Macintosh: Control+click) on a coverage area for which the AP is providing coverage, and select **Edit Properties**. The **Coverage Area Properties** dialog appears.
4. Click the **Associations** tab.
5. Select the AP in the **Available Access Points** group field and click **Add** to move the AP to the **Current Access Points**.
6. Click **OK** to save changes.
7. Click **Objects to Place** in the **Organizer** panel.
8. Click the AP icon, then click on the location where the AP is to be installed. The AP icon moves from the **Objects To Place** panel to the location on the floor.

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Optimizing an RF Plan

Optimizing a network's RF Plan is a performed after a network is fully in service and there is a desire to "tune" or optimize network design and performance. Optimizing a WLAN involves importing updated RF measurements so as to correct RF attenuation and obstacle information used in an initial network plan. You may want to optimize a network's RF plan if you have a reported coverage problem in your network or if you want to verify network RF coverage.

RF measurement data you use to optimize a network plan can originate from:

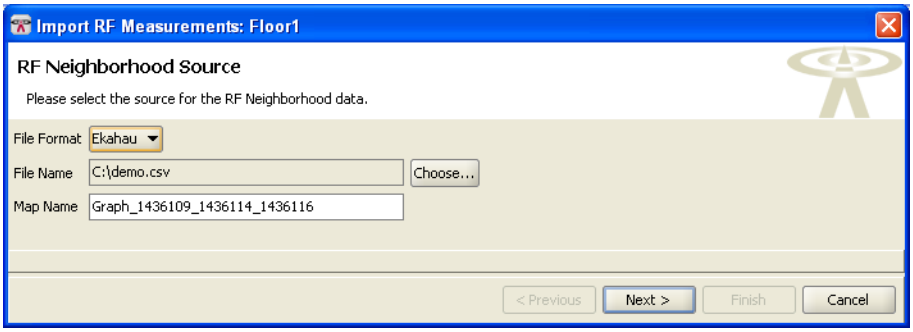
- APs in your network — You can use RF measurements derived from APs. If you use RF measurement data from APs in your network, this data is based on a small set of RF measurements.
- An Ekahau Site Survey™ tool — You can perform a site survey of a network. RF measurements derived from site surveys provide more accurate coverage measurements for a wireless network. Thousands of measurements can be recorded, creating a very accurate RF coverage picture.
- Both APs and a site survey — By importing data into a network plan, you can correct an RF model to reflect real world information. You can update RF attenuation values for obstacles based and replan your network to:
  - Make changes to improve signal strength and/or coverage for groups or individuals.
  - Modify AP locations for optimal results.
  - Add additional equipment to a network.

Using RF Measurements from APs

You can apply RF measurements from APs to a network plan. RF measurements are taken from AP radios. After applying RF measurements, *RingMaster* optimizes an RF model of a floor/area with this data.

To import RF measurements from APs:

1. Select the **RF Planning** option in the main *RingMaster* menu bar.
2. Display a floor plan in the **Content panel**.
3. In the **Tasks** panel, click **RF Planning**.
4. Under **Site Survey**, click **Import Measurement**. The **Import RF Measurements** dialog is displayed.



5. Select **Yes** next to **File**.

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6. Click **Next**. Import progress is displayed. When importing is finished, click **Finish** to accept changes and close the dialog.

After applying network RF measurements, correct attenuation factors for the floor/area. Go to **Optimizing an RF Coverage Model** for more on this topic.

Using RF Measurements from an Ekahau Site Survey

RF measurements can be used from a site survey file generated by the *Ekahau Site Survey™* tool. Choose one of the following to perform a site survey:

- In *RingMaster* — View an RF coverage area.
- In *RingMaster* — Generate a site survey work order, specifying areas you want to survey. A JPEG (**.jpeg** or **.jpg**) file is generated.
- Import the generated JPEG file into the *Ekahau Site Survey* tool.
- Set the scale of the drawing.
- Perform the site survey. Walk through the area, taking measurements with the tool.
- Save the RF measurements in the *Ekahau Site Survey™* tool to a file in comma-separated values (**.csv**) format.
- In *RingMaster* — Import the **.csv** file containing RF measurements into *RingMaster*.
- In *RingMaster* — Optimize to correct attenuation factors.

This chapter guides you through the tasks required to do this in *RingMaster*. For information about the tasks you must complete in the *Ekahau Site Survey* tool, refer to documentation for the *Ekahau* tool. For information about displaying RF coverage areas, refer to **Displaying an RF Coverage Area**.

Generating an Ekahau Site Survey Work Order

A site survey order contains locations and MAC addresses of APs to be used when conducting site surveys, and provides a JPEG image of a floor/area.

To generate a site survey order:

1. Display the floor plan/area drawing in the **Content panel**.
2. In the **Tasks** panel, click **RF Planning**.
3. Under **Site Survey**, click **Report**. The **Site Survey Order Generation** dialog is displayed.
4. Select the scope for generation of a site survey order. You can specify a network plan, an individual site, an individual building, or an individual floor/area.
5. Select the language — English or German.
6. To change the output directory for a report, navigate to the new directory and click **Select**.
7. Click **Generate**.
8. When a report is generated, click a link in the results area to view a report in a browser window. A browser window containing the report is displayed.

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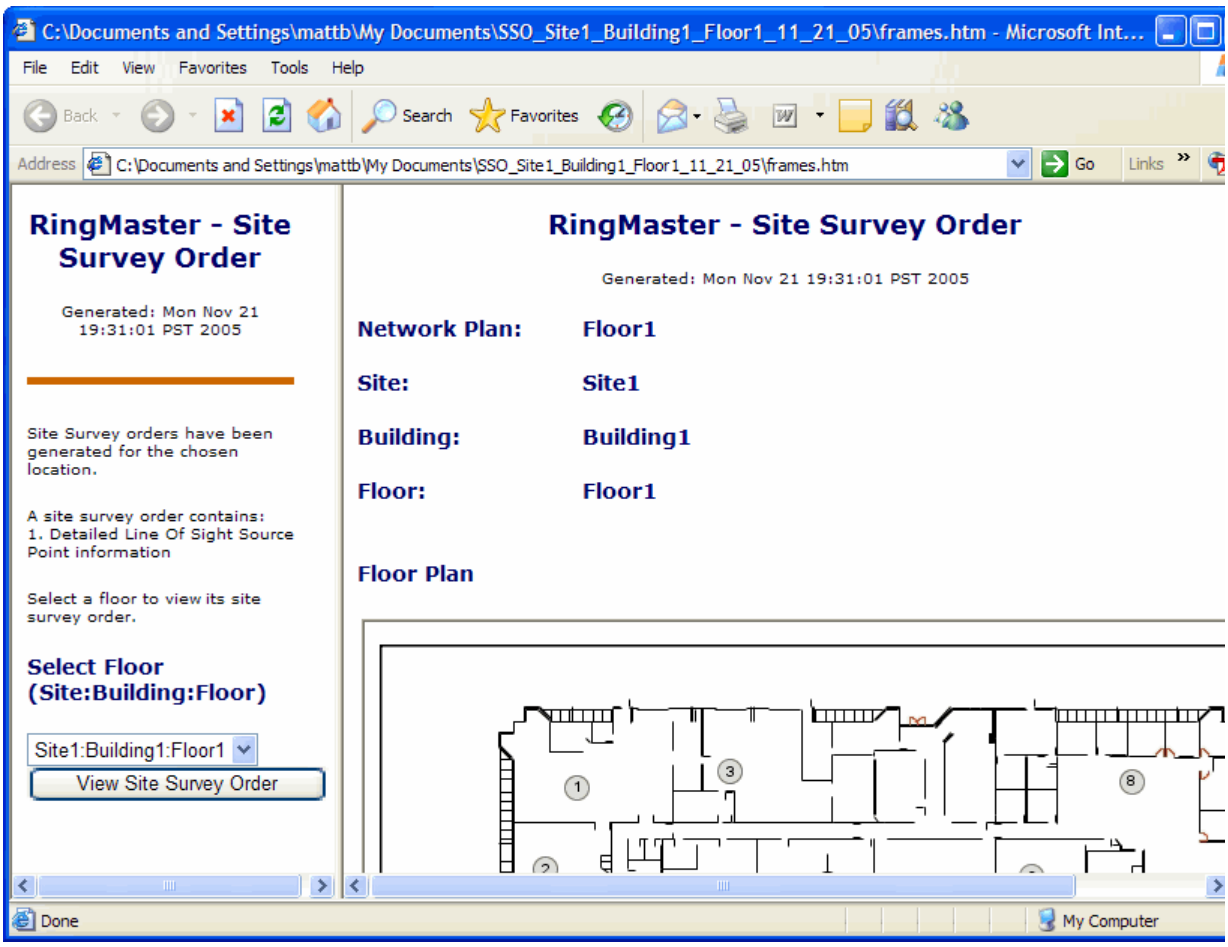
9. Click **View Site Survey Order** to view the site survey work order.


C:\Documents and Settings\mattb\My Documents\SSO_Site1_Building1_Floor1_11_21_05\frames.htm - Microsoft Int...
File Edit View Favorites Tools Help
Back Search Favorites
Address C:\Documents and Settings\mattb\My Documents\SSO_Site1_Building1_Floor1_11_21_05\frames.htm
Go Links
RingMaster - Site Survey Order
Generated: Mon Nov 21 19:31:01 PST 2005
Site Survey orders have been generated for the chosen location.
A site survey order contains:
1. Detailed Line Of Sight Source Point information
Select a floor to view its site survey order.
Select Floor (Site:Building:Floor)
Site1:Building1:Floor1
View Site Survey Order
RingMaster - Site Survey Order
Generated: Mon Nov 21 19:31:01 PST 2005
Network Plan: Floor1
Site: Site1
Building: Building1
Floor: Floor1
Floor Plan
Done
My Computer

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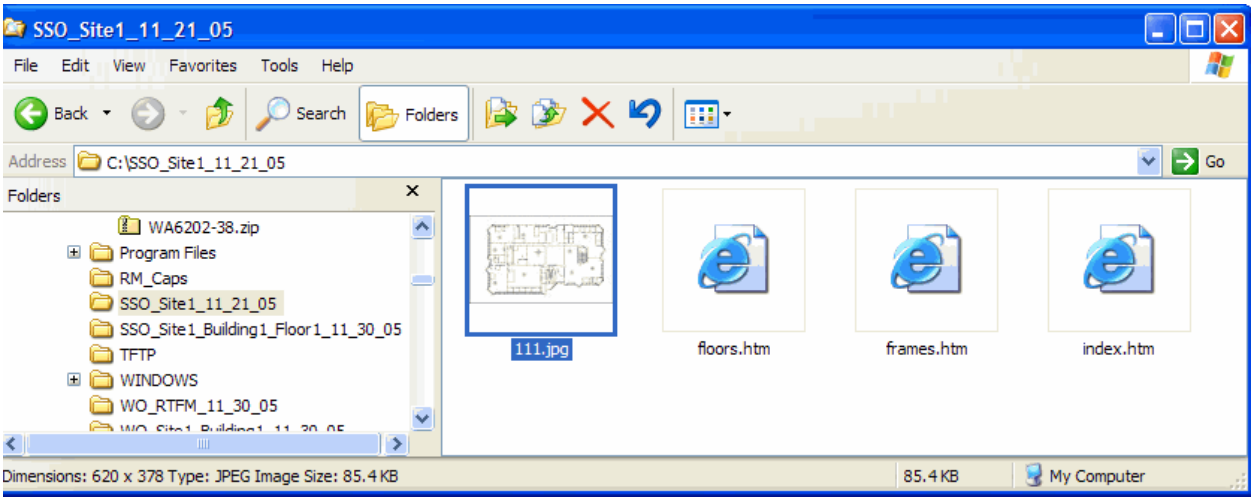
10. Browse to the output directory and locate the JPEG file. Copy this file and import it into your *Ekahau Site Survey* tool. Proceed with your site survey.

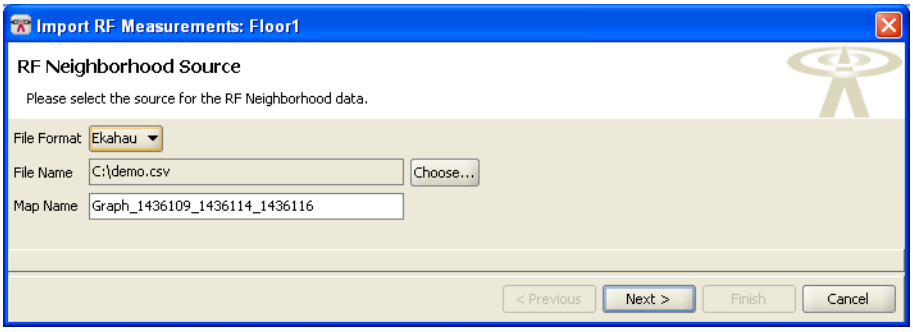


Import RF Measurements from the Ekahau Site Survey

After completing a site survey, import the **.csv** file containing RF measurements from the *Ekahau Site Survey* tool into a network plan. After importing RF measurements, optimize to correct attenuation for obstacles.

To import RF measurements:

1. Display a floor/area plan in the **Content panel**.
2. In the **Tasks** panel, click **RF Planning**.
3. Under **Site Survey**, click **Import Measurement**. The **Import RF Measurements** dialog is displayed.
4. Select **File** as the source of the measurements.
5. Select **Ekahau** from the **File Format** listbox.
6. Click **Choose** to navigate to the csv file with the RF measurement data.
7. In the **Map Name** field, verify a map name.



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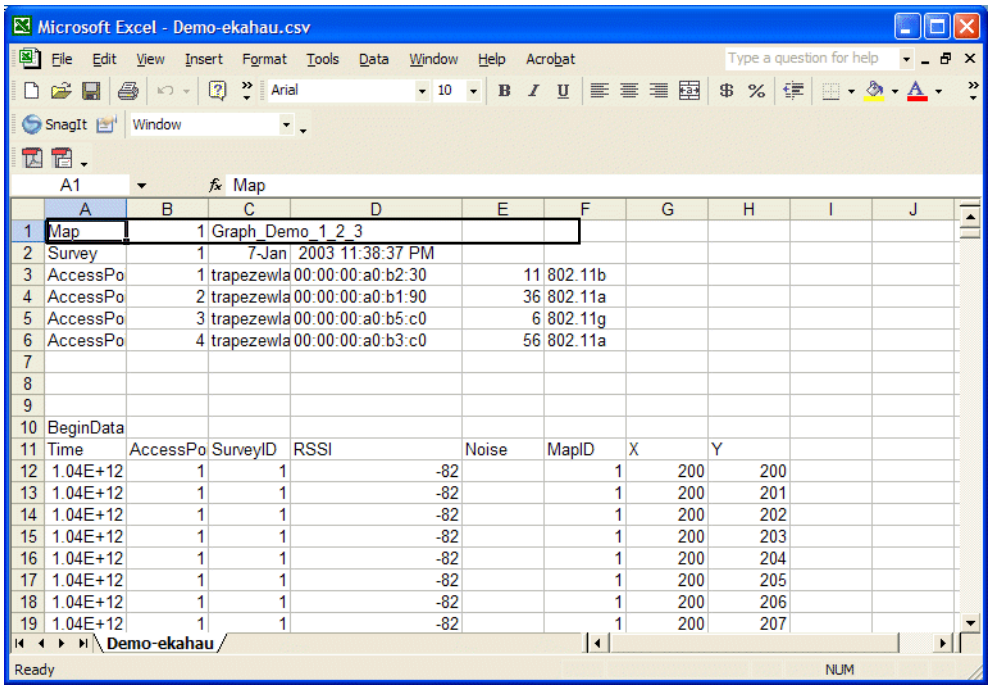
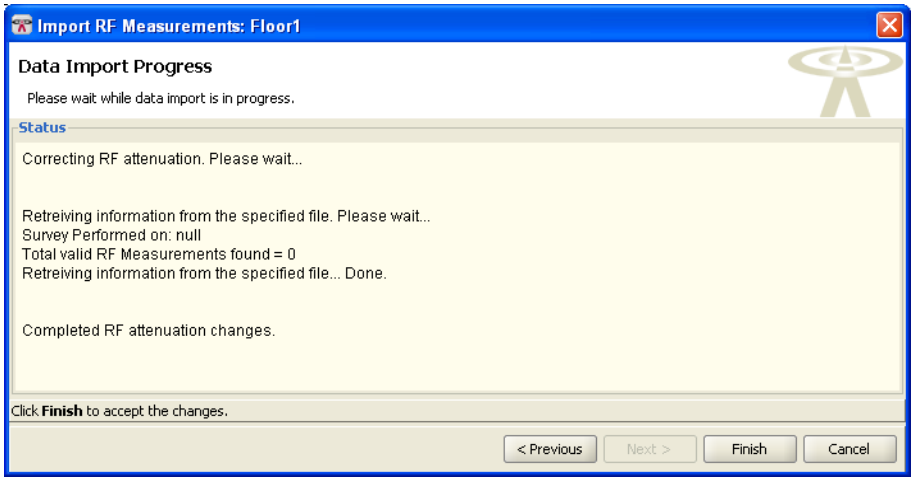
The map name in the **RF Neighborhood Source** dialog must match the map name in the top line of the **.csv** file from the *Ekahau Site Survey* tool.



	A	B	C	D	E	F	G	H	I	J
1	Map	1	Graph_Demo_1_2_3							
2	Survey	1	7-Jan	2003 11:38:37 PM						
3	AccessPo	1	trapezewla	00:00:00:a0:b2:30	11	802.11b				
4	AccessPo	2	trapezewla	00:00:00:a0:b1:90	36	802.11a				
5	AccessPo	3	trapezewla	00:00:00:a0:b5:c0	6	802.11g				
6	AccessPo	4	trapezewla	00:00:00:a0:b3:c0	56	802.11a				
7										
8										
9										
10	BeginData									
11	Time	AccessPo	SurveyID	RSSI	Noise	MapID	X	Y		
12	1.04E+12	1	1	-82		1	200	200		
13	1.04E+12	1	1	-82		1	200	201		
14	1.04E+12	1	1	-82		1	200	202		
15	1.04E+12	1	1	-82		1	200	203		
16	1.04E+12	1	1	-82		1	200	204		
17	1.04E+12	1	1	-82		1	200	205		
18	1.04E+12	1	1	-82		1	200	206		
19	1.04E+12	1	1	-82		1	200	207		

8. Click **Next**. Import progress is displayed. When importing is complete, check the **Total valid RF measurements found** line in the progress messages.
   - If the number is greater than **0**, *RingMaster* successfully imported measurements.
   - If the number is **0**, no measurements were imported. Try the import again. If you are using a site survey file, verify that the map name is correct.


Import RF Measurements: Floor1
Data Import Progress
Please wait while data import is in progress.
Status
Correcting RF attenuation. Please wait...
Retreiving information from the specified file. Please wait...
Survey Performed on: null
Total valid RF Measurements found = 0
Retreiving information from the specified file... Done.
Completed RF attenuation changes.
Click Finish to accept the changes.
< Previous
Next >
Finish
Cancel

After importing RF measurements, correct the attenuation factors for the floor.

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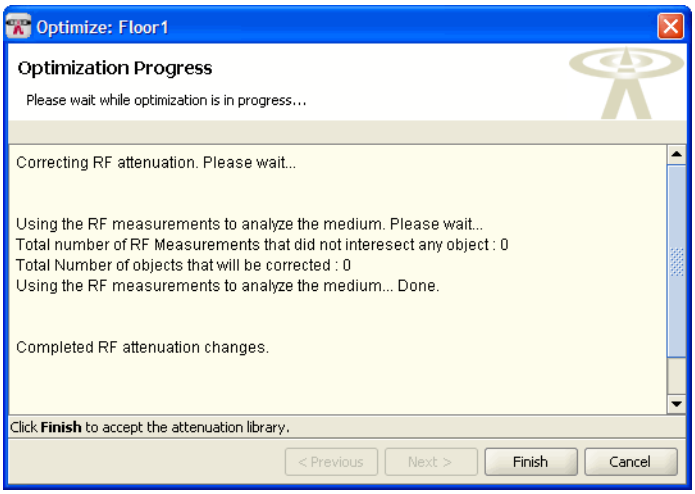
Optimizing an RF Coverage Model

An attenuation library is a set of attenuation values for the RF obstacles on a floor. After importing RF measurements from a site survey or applying them from the RF measurements to your network plan, rebuild the attenuation library for a floor using those RF measurements.

1. Display the floor plan in the **Content** panel.
2. In the **Tasks** panel, click **RF Planning**.
3. Under **Site Survey** in the **Tasks** panel, click **Optimize**. A dialog appears, displaying the request progres.


Optimize: Floor1
Optimization Progress
Please wait while optimization is in progress...
Correcting RF attenuation. Please wait...
Using the RF measurements to analyze the medium. Please wait...
Total number of RF Measurements that did not interesect any object : 0
Total Number of objects that will be corrected : 0
Using the RF measurements to analyze the medium... Done.
Completed RF attenuation changes.
Click Finish to accept the attenuation library.
< Previous
Next >
Finish
Cancel

- The **Total number of RF measurements that did not intersect any object** line lists the number of measurements that were not attenuated due to an RF obstacle in the path between them. If measurements came from a site survey, these are measurements between deployed APs and a Ekahau Site Survey tool performing the survey. If the measurements came from AP radios in the network, these are measurements between AP radios.
- The **Total number of objects that will be corrected** line indicates the number of measurements that did attenuate. For existing RF objects, RingMaster corrects the attenuation to match the results. If the floor plan does not have an RF obstacle where the attenuation library indicates one exists, *RingMaster* creates an RF obstacle. For RF obstacles created by *RingMaster*, the description is **auto-generated** and the obstacle type is **Other**. You can edit these values by selecting the obstacle, clicking the **Edit properties** icon to open the **Modify RF Obstacle** dialog and modify values. Click **Finish** to close the dialog and save changes.

Click **Finish**.

You have optimized your RF coverage model with new RF obstacle information. Now you can locate and fix coverage holes, or if necessary, replan your network.

Locating and Fixing Coverage Holes

After importing RF measurements and rebuilding an attenuation library, look for coverage holes by displaying coverage.

Perform the following steps to locate coverage holes:

1. Display the optimized RF coverage area to view corrected attenuation data.
2. Lock down deployed APs in a coverage area to prevent *RingMaster* from moving APs in a network plan during the compute and place process.
3. Compute and place APs.
4. Replan your network based on compute and place results.

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Displaying an RF Coverage Area

To display an RF coverage area:

1. Select the **RF Planning** option in the main *RingMaster* Navigation Bar.
2. Display a floor plan in the **Content panel**.
3. In the **Tasks** panel, click **RF Planning**.
4. In the **Coverage Areas** section of the **Organizer** panel, select the scope for which you want to display coverage. You can display coverage for an individual radio, a specific coverage area, or all coverage areas on the floor or in an area.
   - To select multiple contiguous objects, click **Shift** while selecting.
   - To select multiple non-contiguous objects, click **Ctrl** (Macintosh: **Command**) while selecting.
5. On the toolbar, click the radio type (**A**, **B**, or **G**) to display coverage. Coverage for selected scope(s) is displayed.

Locking Down APs

To prevent *RingMaster* from moving an AP on a network plan, lock it down as follows:

1. Display an RF coverage area.
2. Right-click (Macintosh: Control+click) on an AP in the RF coverage area, and select **Lock Position**.

Fixing Coverage Holes

After importing RF measurements, rebuilding an attenuation library, and displaying coverage, you can see any wireless coverage holes in a network.

To fix a coverage hole, use one of the following methods:

- Lock APs in place, and use the **Compute and Place** task to recompute the number of APs needed and their recommended placement. If additional APs are needed, install new APs.
- Install new APs and add them to a network plan. Using this method, you install new APs and then integrate them into a network plan.

Computing and Placing New APs

The procedure for computing and placing new APs is the same as during initial planning.Using this procedure, you determine the number and location of additional APs you should add to a network.

Adding APs Already Installed to a Network Plan

If you install a new AP in a network and want to add it to the network plan, do the following:

1. Select the **RF Planning** button on the main *RingMaster* Navigation Bar and display a floor plan in the **Content** panel.
2. Click on **Objects to Place** in the **Organizer** panel. Click on an AP icon, then click the location where you installed it. The AP icon moves to its location on the floor.

Placing an AP in a Coverage Area

After computing and placing APs in a network plan, install APs to a network. For information about adding APs, refer to the *Juniper Mobility Point MP-422 Installation Guide* or *Juniper Mobility Point MP-620 Installation Guide.* These guides contain instructions for installing MP access points and connecting them to an MX.

After installing an AP in a network and adding it to a network plan, do the following:

1. Select the **RF Planning** menu bar option.
2. In the **Content panel**, display a floor plan to install the AP.
3. In the **Organizer panel**, click on **Coverage Areas**.

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4. Right-click (Macintosh: Control+click) the Coverage Area to associate the AP, and select **Edit Properties** from the menu. The **Coverage Area Properties** dialog for the selected coverage area appears.
5. Click the **Access Points** tab to display area associations information for the coverage area.
6. In the **Available Access Points** field, select one or more available APs to use in the coverage area, then click **Add** to move the APs to the **Current Access Points** field.
7. Click **OK** to close the dialog box.
8. In the **Organizer panel**, click **Objects to Place**. A list of the created APs is displayed in the panel.
9. Click the **AP** icon, then click on a location where you installed the AP. The **AP** icon moves from the **Objects To Place** panel to the specified location on the floor. You can create a backup copy of your updated network plan and distribute *RingMaster* configuration settings to other MXs.

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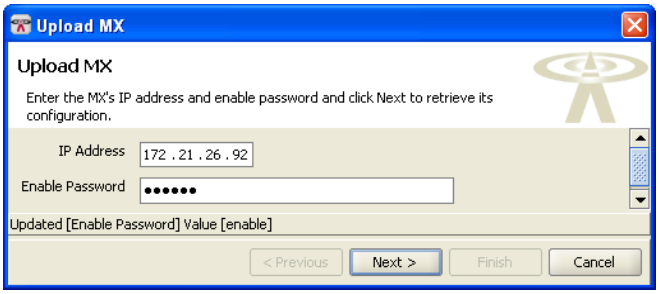
RF Plan Verification and Deployment

You can use the following tools to help verify a wireless network:

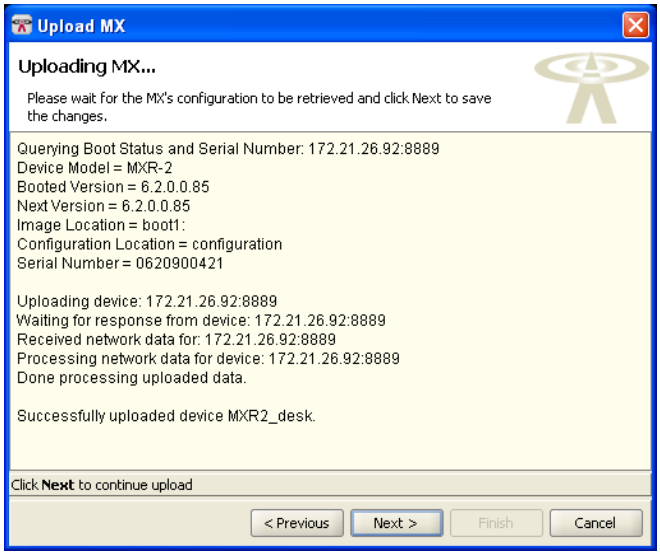
- **Uploading an MX into a Network Plan**
- **Showing RF Coverage**
- **Placing RF Measurement Points**
- **Using RF Interactive Measurement Mode**

Uploading an MX into a Network Plan

1. Select the **Configuration** Navigation Bar button.
2. In the **Tasks** panel, select **Upload MX**.


Upload MX
Upload MX
Enter the MX's IP address and enable password and click Next to retrieve its configuration.
IP Address
172 . 21 . 26 . 92
Enable Password
Updated [Enable Password] Value [enable]
< Previous
Next >
Finish
Cancel

3. In the **IP Address** field, type the IP address for an MX.
4. In the **Enable Password** field, type the enable password for the MX. This password must match the enable password defined using the CLI command **set enablepass**. For more information, see the *Juniper Mobility System Software Configuration Guide.*
5. Click **Next**. The uploading progress is displayed.


Upload MX
Uploading MX...
Please wait for the MX's configuration to be retrieved and click Next to save the changes.
Querying Boot Status and Serial Number: 172.21.26.92:8889
Device Model = MXR-2
Booted Version = 6.2.0.0.85
Next Version = 6.2.0.0.85
Image Location = boot1:
Configuration Location = configuration
Serial Number = 0620900421
Uploading device: 172.21.26.92:8889
Waiting for response from device: 172.21.26.92:8889
Received network data for: 172.21.26.92:8889
Processing network data for device: 172.21.26.92:8889
Done processing uploaded data.
Successfully uploaded device MXR2_desk.
Click Next to continue upload
< Previous
Next >
Finish
Cancel

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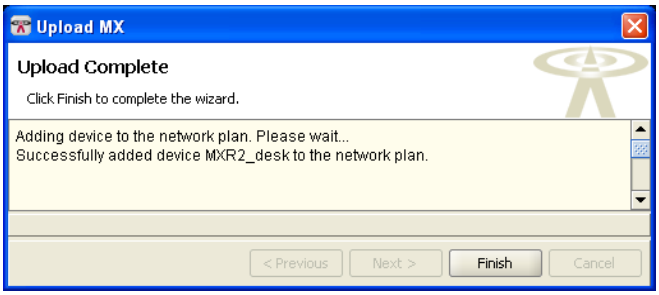
6. After the **Successfully uploaded device** message is displayed, click **Finish**.


Upload MX
Upload Complete
Click Finish to complete the wizard.
Adding device to the network plan. Please wait...
Successfully added device MXR2_desk to the network plan.
< Previous
Next >
Finish
Cancel

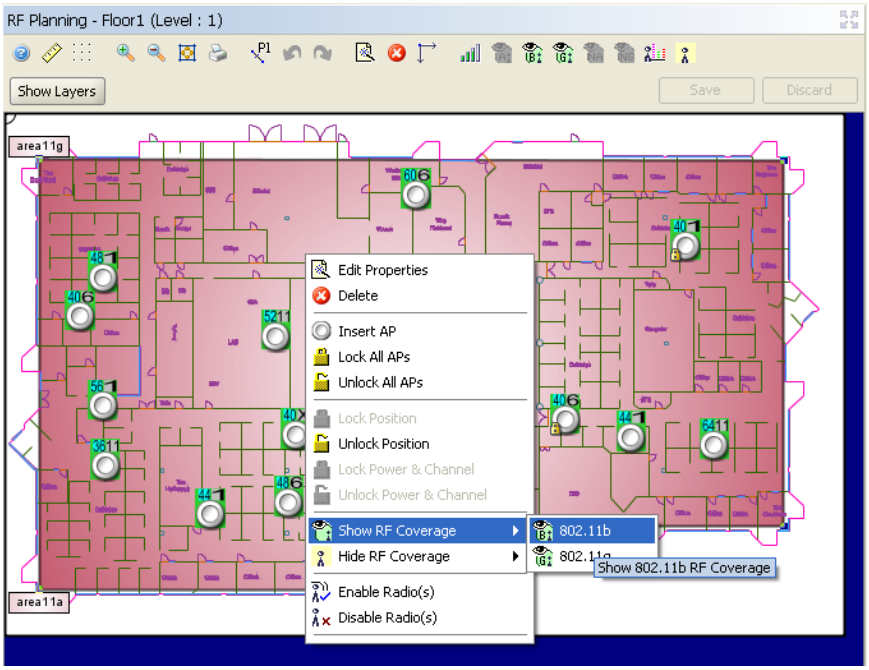
If *RingMaster* displayed error or warning messages, select the **Verification** Navigation Bar button and go to “Verifying Configuration Changes” in the publication *RingMaster 7.4*

Showing RF Coverage

Looking at RF coverage allows you to see if an area is adequately covered by AP access points. You can move APs and see changes in coverage.

You can display RF coverage for an area as follows:

1. In the **Coverage Areas** section of the **Organizer** panel, select a coverage area.
2. Right-click (Macintosh: Control+click), and select **Show RF Coverage**. This displays coverage provided by access points on a single floor. To view coverage provided to a current floor from access points on the floor above or below, do the following.
   a. In the Coverage Areas section of the Organizer panel, navigate to the floor.
   b. Expand the floor to display the coverage areas.
   c. Right-click (Macintosh: Control+click) on a coverage area, and select Show RF Coverage.



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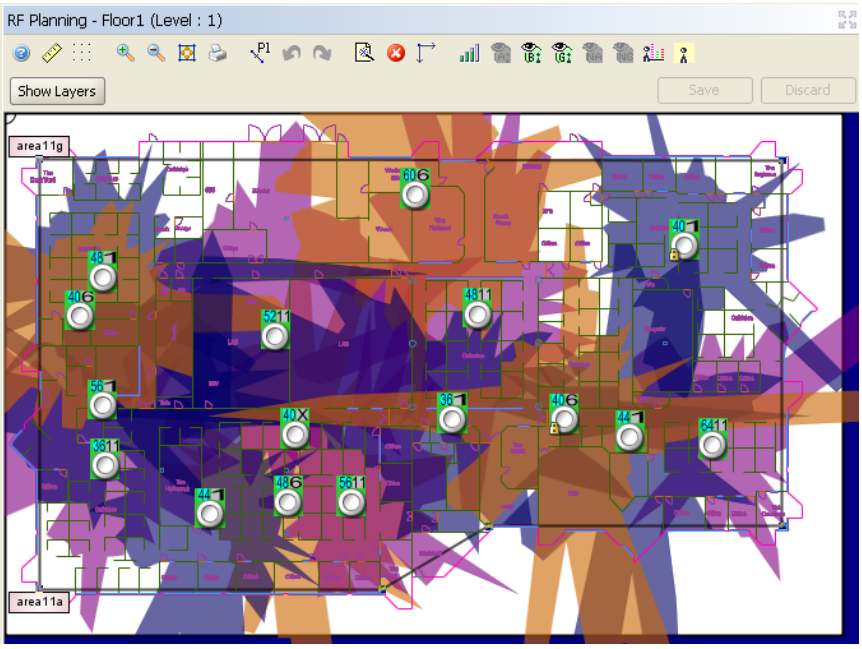
3. This presents a window like the one shown below for the selected technology.



If the coverage area provided by an access point on the floor above or below is one meter or less, *RingMaster* displays a message. This coverage area is not displayed on the current floor plan.

Resolving Coverage Gaps

You might see small “holes” when looking at coverage areas at the baseline association rate. These holes are areas where users will have wireless access but not at the baseline association rate. In most situations, increasing transmit power levels to close holes generates more co-channel interference. You should probably allow small holes during the planning process.

If you need to resolve gaps in coverage, try the following:

1. From the **Visualization** area in the **Tasks** panel, there are several tools:
   - **RF Coverage** — Coverage is shown in colored bands representing coverage by technology.
   - **Data Rate** — Coverage is shown in colored bands representing data transmission rates supported by a radio. These rates are standard for each radio type.
   - **Location Accuracy** — Coverage is shown based on location accuracy of radios.
   - **RSSI** — Coverage is shown based on Received Signal Strength Indication (RSSI) at other radios.
   - **Clear Visualization** — Clears visualization displays.

If you need to make adjustments, do the following:

1. Move AP access points, or increase transmit power levels to provide better coverage.
2. Create more AP access points, and place them on the floor.
3. Modify the coverage area so that capacity requirements are higher.

If you manually add AP access points to a coverage area, they might be moved or removed when you next perform **Compute and Place**.

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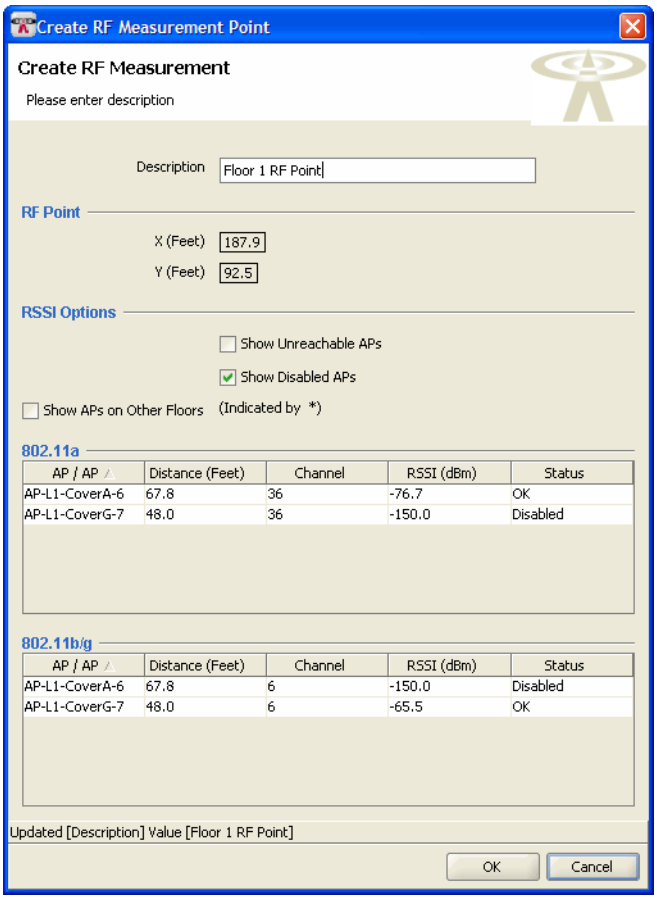
If you have installed an AP in a network and you want to add it to a coverage area, see "Adding New APs that Are Already Installed to the Network Plan" in the publication *RingMaster 7.4 Configuration Guide*.

Placing RF Measurement Points

An RF measurement point on a floor plan simulates measurements of signal strength from all AP access points at a specific position on the floor. Placing RF measurement points is optional. RF measurement points are helpful for verifying a wireless network, and you can place as many RF measurement points as you want. You can place them anywhere and move them. Information from RF measurement points is included in the work order for a floor.

To place an RF measurement point:

1. Display the floor plan in the **Content** panel.
2. In the **Tasks** panel, click **Tools**.
3. In the **Coverage Area** task group, under **Wiring Closet/Misc**, click the (**Insert Measurement Point**) icon.
4. On the floor plan, click where you want a measurement point to be placed. The **Create RF Measurement Point** dialog box appears.



5. In the **Description** field, type a description for the measurement point (1 to 60 characters).
6. In the **RSSI Options** field, select display options for the dialog box:
   - To list access points that cannot be detected from this RF measurement point, select **Show Unreachable APs**.

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- To list disabled access points, select **Show Disabled APs**.
- To list access on other floors that can be detected from this RF measurement point, select **Show APs on Other Floors**.

See **Reading the RF Measurement Table** for information about fields in the display.

7. Click **OK** to save changes and close the box.
8. Do one of the following:
   a. To use RF interactive measurements, see **Using RF Interactive Measurement Mode**.
   b. To generate network design information, see **Generating RF Network Design Information**.

Using RF Interactive Measurement Mode

RF interactive measurement mode is useful when you are troubleshooting or surveying the coverage areas on the floor. You can quickly measure signal strengths for any location on the floor.

To use the RF interactive measurement mode:

1. Click the icon in the context toolbar.
2. Click any location on the floor. RSSI measurements for the selected location appear next to the **Floor View**. See **Reading the RF Measurement Table** for information about fields in the display.

Reading the RF Measurement Table

Projected signal strengths for planned equipment from that measurement point are displayed in the RF measurement table. X-Y coordinates for measurement point and display options are also available to

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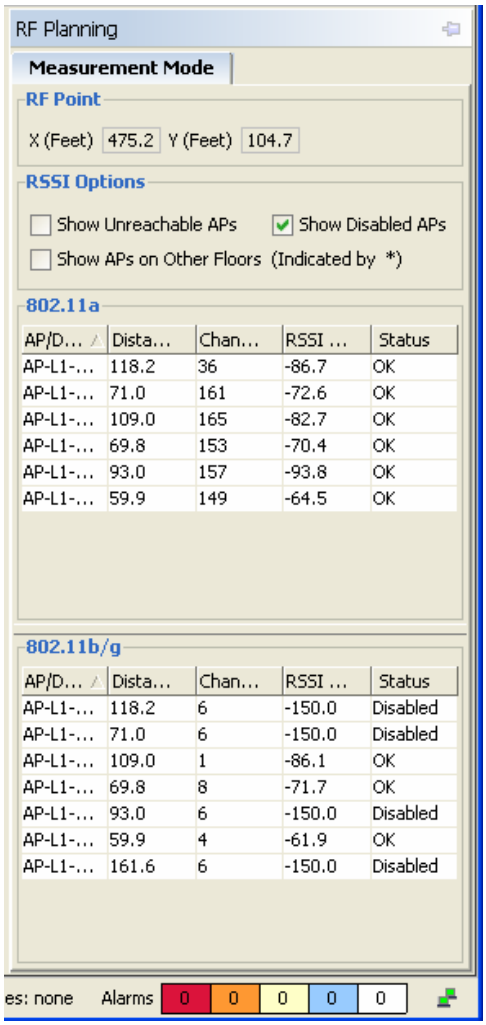
customize the RSSI table. Using this interactive mode can be valuable when verifying deployment coverage with a portable WLAN measurement tool on the floor.


RF Planning
Measurement Mode
RF Point
X (Feet) 475.2 Y (Feet) 104.7
RSSI Options
Show Unreachable APs
Show Disabled APs
Show APs on Other Floors (Indicated by *)
802.11a
AP/D... Dista... Chan... RSSI ... Status
AP-L1-... 118.2 36 -86.7 OK
AP-L1-... 71.0 161 -72.6 OK
AP-L1-... 109.0 165 -82.7 OK
AP-L1-... 69.8 153 -70.4 OK
AP-L1-... 93.0 157 -93.8 OK
AP-L1-... 59.9 149 -64.5 OK
802.11b/g
AP/D... Dista... Chan... RSSI ... Status
AP-L1-... 118.2 6 -150.0 Disabled
AP-L1-... 71.0 6 -150.0 Disabled
AP-L1-... 109.0 1 -86.1 OK
AP-L1-... 69.8 8 -71.7 OK
AP-L1-... 93.0 6 -150.0 Disabled
AP-L1-... 59.9 4 -61.9 OK
AP-L1-... 161.6 6 -150.0 Disabled
es: none
Alarms 0 0 0 0 0

You can exit Measurement Mode by clicking on the **Radio Bars** icon.

Table 4– 5 shows information available in the **RF Measurement** table.

Table 7– 1. RF Measurement Information

Item	Value
X	Distance in the X direction from the 0,0 coordinate (the upper left corner of the panel).
Y	Distance in the Y direction from the 0,0 coordinate (the upper left corner of the panel).
Show Unreachable APs	Show AP access points that are too far away to accurately measure signal strength.

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Table 7– 1. RF Measurement Information (continued)

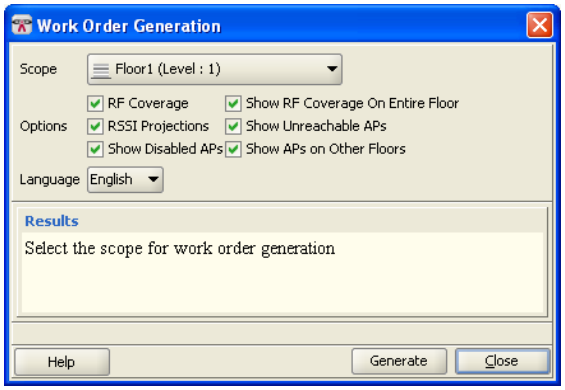
Item	Value
Show Disabled APs	Show all disabled AP access points.
Show APs on Other Floors	Show the APs located on other floors that can be detected from this RF measurement point.
AP/AP	AP or third-party access points detected.
Distance	Distance between AP and RF measurement point.
Channel	Channel of the AP or third-party access point.
RSSI (dBm)	Signal strength from the AP at the RF measurement point.
Status	Whether the AP is active (OK) or disabled.

Generating RF Network Design Information

After **RingMaster** has calculated the number of AP access points required to provide wireless coverage, you generate a work order report. This work order report provides information for the physical installation of the Juniper Mobility System. A work order indicates where AP access points should be installed, MX initial configuration information, and projected RSSI information that is useful when verifying the installation. After deployment, you can generate a work order with the optional RSSI projection tables and AP MAC addresses, and use it for post-deployment verification.

To generate a work order report:

1. Display the floor plan in the **Content** panel.
2. In the **Tasks** panel, click **RF Planning**.
3. Under **RF Planning**, click **Work Order Report**. The **Work Order Generation** dialog is displayed.



4. Specify whether to include the following information in the work order:
   - RF Coverage
   - RSSI Projections
   - Show Disabled APs (only available if RSSI Projections is selected)
   - Show RF Coverage On Entire Floor (only available if RSSI Projections is selected)
   - Show Unreachable APs (only available if RSSI Projections is selected)
   - Show APs on Other Floors (only available if RSSI Projections is selected)

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5. From the Language list, select **English** or **German**. The language you select is the language used when you next access this page.
6. To select a directory where the inventory report is saved, click **Choose**. The **Select** dialog box appears.
7. Navigate to the directory you want, and click **Select**. *RingMaster* uses this directory when generating subsequent reports. For *Linux* systems, the default directory is the home directory of the user running *RingMaster*.
8. Click **Generate Work Order**. The work order is saved in the directory specified with a name in the format **WO_scope_name_date**. If you generate another order for the same scope on the same day, the old work order is overwritten. When a work order has been generated, a hyperlink becomes available.
9. Click the hyperlink. A browser window opens to display the work order in HTML format.

10. Select a floor from the **Select Floor** list and click **View Work Order**. The work order is displayed starting at the floor specified. You can scroll to view additional information.
11. Click **Close** to close the dialog.

Installing Network Equipment

After printing work orders from *RingMaster*, you can distribute them to installers. Work orders show where to install equipment. If you have specified third-party APs in a network plan, those are also considered in work orders.

A *RingMaster* network plan can support both RF Auto-Tuning and RF Planning techniques at the same time. You can use RF Auto-Tuning to meet the demands of rapid network changes that can be caused by a greater or lesser number of users, or by a physical blockage of APs.

To fine tune your network RF coverage area and performance, refer to **Optimizing an RF Coverage Model**.

Deploying a Network Plan

To deploy your network plan and enable and configure monitoring, refer to the publications *RingMaster 7.4 Configuration Guide* and *RingMaster 7.4 Management Guide*.

Traffic Ports Used by MSS

When deploying a Juniper wireless network, you might add Juniper equipment to subnets with firewalls or access controls between them. Juniper equipment uses various protocol ports to exchange information. To ensure full operation of your network, make sure the equipment can exchange information on the ports listed in **Table 7– 2**.

Table 7– 2. Traffic Ports Used by MSS

Protocol	Port	Function
IP/TCP (6)	23	Telnet management
IP/TCP (6)	443	SSL management of an MX via Web View Port 443 is also the default port used by RingMaster Clients to communicate with a RingMaster server.
IP/TCP (6)	8821	Network Domain and Mobility Domain management The originating MX makes a connection from a random TCP port that is equal to or higher than 4096. The target MX listens for the traffic on TCP port 8821.
IP/TCP (6)	8889	SSL management via *RingMaster* or GuestPass *RingMaster* or GuestPass originates the SSL connection on TCP port 8889.

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Table 7– 2. Traffic Ports Used by MSS (continued)

Protocol	Port	Function
IP/UDP (17)	53	DNS
IP/UDP (17)	123	NTP
IP/UDP (17)	161	SNMP get and set operations
IP/UDP (17)	162	SNMP traps
IP/UDP (17)	1812	RADIUS authentication (default setting)
IP/UDP (17)	1813	RADIUS accounting (default setting)
IP/UDP (17)	5000	MX-AP communication. This applies to MX communication with Distributed APs and with directly connected APs.
IP/ICAP (1)	N/A	Several types (for example, ping)

Roaming traffic uses IP tunnels, encapsulated with IP protocol 4. To list TCP port numbers in use on an MX, including those for the other end of a connection, use the *show tcp* command.

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